User's Manual

EXA RC

Model RC400G Residual Chlorine Analyzer

[Style: S3]

IM 12F4A1-01E

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YOKOGAWA
Yokogawa Electric Corporation

IM 12F4A1-01E
8th Edition

Introduction

The RC400G Residual Chlorine Analyzer is a process analyzer for continuous measurement of free chlorine concentration and residual chlorine contained in chlorine-treated water.

1. Confirmation of Specifications

The RC400G comprises Tap Water type (RC400G-1), Raw Water type (RC400G-2) and Treated Water type (RC400G-3).

When the RC400G has been delivered to your location, carefully unpack and check the equipment for any transportation damage, and ensure that the equipment is of the correct specifications as ordered. Confirm this by the model code indicated on the nameplate or the package tag referring to Chapter 2 of this manual.

NOTE

1. Unpack the equipment at a location close to its installation site.
2. Locate on power to read to version number of ROM loaded on the equipment. Then, follow the procedures as instructed in item (10) of subsection 5.3.3 after completion of the installation work, such as wiring.

2. Caution for Transfer and Storage

Observe the following notices so as not to damage the RC400G on transfer and storage.

- When transferring the RC400G to its installation site or elsewhere, prevent the equipment from receiving strong impact, and exercise care to minimize the vibration received.

CAUTION

Carry the RC400G in the same attitude as it will be installed. the RC400G weight exceeds 60 kg. (For details, see subsection 2.1.1.)

- For storing the RC400G, select a place where the ambient temperature is in the range of from -30 to 70 °C. Humidity must be of a level that does not result in dew condensation. Exposure to corrosive gases or water splash must be avoided as well.

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3. Content of User's Manual

This user's manual fully describes the handling of the RC400G, including installation, wiring, operation, inspection/maintenance and so forth.

Operating principle and specifications are also shown to help in the understanding of the RC400G Residual Chlorine Analyzer.

To achieve full performance of this equipment, the user id recommended to peruse this manual before handling the equipment.

This manual also introduces various peripheral equipment prepared by Yokogawa such as the RC401G Reagent Tank which is used in combination with the RC400G analyzer.

Note: This manual does not describe any equipment or attachments that are supplied on special order.

CAUTION

If this manual is used during the planning stage in advance of equipment order placement, please be note that the content of this manual is subject to change without prior notice for product improvement or other reasons.

When the manual is revised, the edition number or version number in the cover of the manual changes.

◆ Safety Precautions

■ Safety, Protection, and Modification of the Product

- In order to protect the system controlled by the product and the product itself and ensure safe operation, observe the safety precautions described in this user's manual. We assume no liability for safety if users fail to observe these instructions when operating the product.
- If this instrument is used in a manner not specified in this user's manual, the protection provided by this instrument may be impaired.
- If any protection or safety circuit is required for the system controlled by the product or for the product itself, prepare it separately.
- Be sure to use the spare parts approved by Yokogawa Electric Corporation (hereafter simply referred to as YOKOGAWA) when replacing parts or consumables.
- Modification of the product is strictly prohibited.
- The following symbols are used in the product and user's manual to indicate that there are precautions for safety:

Symbol Marks

Throughout this user's manual, you will find several different types of symbols are used to identify different sections of text. This section describes these icons.

CAUTION

Identifies instructions that must be observed in order to avoid physical injury and electric shock or death of the operator.

WARNING

Identifies instructions that must be observed in order to prevent the software or hardware from being damaged or the system from becoming faulty.

NOTE

Identifies information required to understand operations or functions.

Notes on Handling User's Manuals

- Please hand over the user's manuals to your end users so that they can keep the user's manuals on hand for convenient reference.
- Please read the information thoroughly before using the product.
- The purpose of these user's manuals is not to warrant that the product is well suited to any particular purpose but rather to describe the functional details of the product.
- No part of the user's manuals may be transferred or reproduced without prior written consent from YOKOGAWA.
- YOKOGAWA reserves the right to make improvements in the user's manuals and product at any time, without notice or obligation.
- If you have any questions, or you find mistakes or omissions in the user's manuals, please contact our sales representative or your local distributor.

Warning and Disclaimer

The product is provided on an "as is" basis. YOKOGAWA shall have neither liability nor responsibility to any person or entity with respect to any direct or indirect loss or damage arising from using the product or any defect of the product that YOKOGAWA can not predict in advance.

◆ After-sales Warranty

■ Do not modify the product.

■ During the warranty period, for repair under warranty carry consult local sales representative or service office. Yokogawa will replace or repair any damaged parts. Before consulting a product for repair under warranty, provide us with the model name and serial number and a description of the problem. Any diagrams or data explaining the problem would also be appreciated.

- If we replace the product with a new one, we won't provide you with a repair report.
- Yokogawa warrants the product for the period stated in the pre-purchase quotation Yokogawa shall conduct defined warranty service based on its standard. When the customer site is located outside of the service area, a fee for dispatching the maintenance engineer will be charged to the customer.

■ In the following cases, customer will be charged repair fee regardless of warranty period.

- Failure of components which are out of scope of warranty stated in instruction manual.
- Failure caused by usage of software, hardware or auxiliary equipment, which Yokogawa Electric did not supply.
- Failure due to improper or insufficient maintenance by user.
- Failure due to modification, misuse or outside-of-specifications operation which Yokogawa does not authorize.
- Failure due to power supply (voltage, frequency) being outside specifications or abnormal.
- Failure caused by any usage out of scope of recommended usage.
- Any damage from fire, earthquake, storms and floods, lightning, disturbances, riots, warfare, radiation and other natural changes.

■ Yokogawa does not warrant conformance with the specific application at the user site. Yokogawa will not bear direct/indirect responsibility for damage due to a specific application.

■ Yokogawa Electric will not bear responsibility when the user configures the product into systems or resells the product.

■ Maintenance service and supplying repair parts will be covered for five years after the production ends. For repair for this product, please contact the nearest sales office described in this instruction manual.

Model RC400G
Residual Chlorine Analyzer
[Style: S3]

IM 12F4A1-01E 8th Edition

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Revision Information i

1. Outline

In chlorinated tap water and industrial water, the chlorination effect can be determined by measuring residual chlorine contact.

The RC400G Residual Chlorine Analyzer is for process use and employs rotating electrode polarography as its measuring principle.

It can be used for continuous measurement of residual chlorine composed of free available chlorine and combined available chlorine or for free available chlorine only.

The RC400G Residual Chlorine Analyzer includes "Tap Water type (Model RC400G-1)" suitable for measurement of tap water or filtered water, "Raw Water type (Model RC400G-2)" suitable for measurement of raw water and "Treated Water type (Model RC400G-3)" suitable for measurement of treated water such as sewer water after secondary treatment or plant waste water.

Combined Chlorine Insensitive Version

If raw water contains large quantities of ammonia nitrogen, combined chlorine will form and remain in the reaction process even if necessary and sufficient chlorine is added at prechlorination point. In particular, when the pH and temperature of the water are low, combined chlorine (dichloramine) remains longer and breaks down slowly.

In measurement of free available chlorine in sample water that contains a high concentration of combined chlorine, measurement errors may occur when the previous model of residual chlorine analyzer is used. To solve this problem the combined chlorine insensitive version should be used. It has modified electrode and reagent composition, thereby improving sensitivity to free available chlorine in the presence of combined chlorine. The electrode configuration, reagent composition and applied voltage have been changed, otherwise, the measurement principle, equipment, specifications and performance remain unchanged from the previous model.

In this chapter, the operating principle and structural outline of the RC400G Residual Chlorine Analyzer is described.

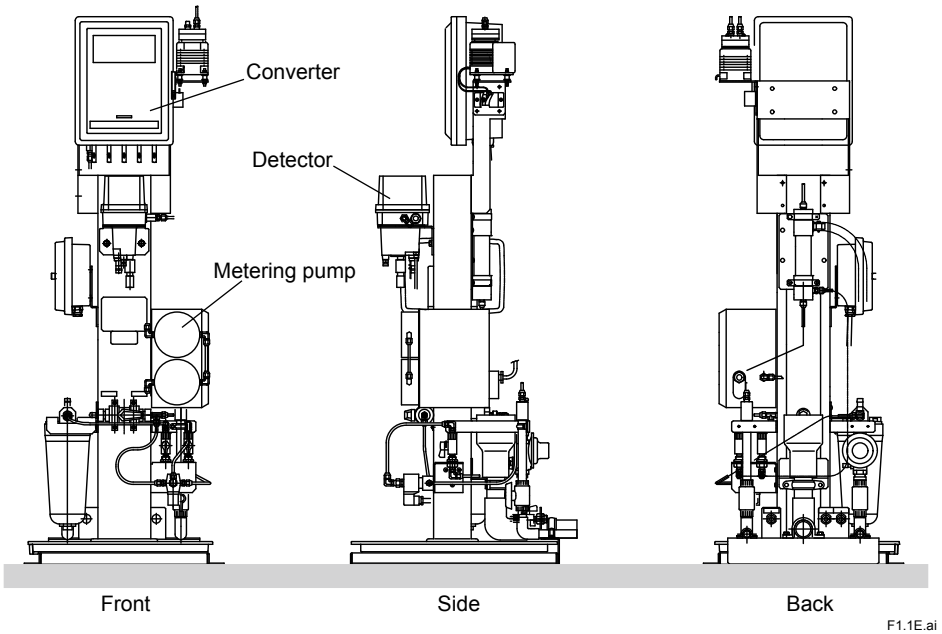


Figure 1.1 Appearance of RC400G Residual Chlorine Analyzer (RC400G-1, Tap Water type)

1.1 RC400G Residual Chlorine Analyzer Configuration

The RC400G Residual Chlorine Analyzer is mainly composed of a “measuring system”, a “sampling system” and an “air tubing system”.

In addition, a “cleaning piping system” is added to raw water treated water analyzers.

Measuring System

“Measuring System” mainly consists of a detector and a converter.

The detector contains a measuring tank and an electrode mechanism block. The electrode mechanism block incorporates two electrodes, indicator electrode (gold alloy electrode) and counter electrode (platinum electrode with built-in Pt1000 temperature sensor), and a drive assembly composed of a starting motor for rotating the indicator electrode at a constant speed, a drive belt, etc.

The electrodes obtain diffusion currents by electrolytic reduction of iodine (for measuring total residual chlorine) or bromine (for measuring free available chlorine) in the plateau region, which is liberated corresponding to sample water chlorine concentration in mixed solution of sample water with reagent fed into the measuring tank. The electrodes also serve to obtain a signal for automatic temperature compensation of the diffusion current which varies with temperature.

The measuring tank is made of acrylic resin, and the place of indicator electrode insertion houses the glass beads for polishing the electrode.

The measuring circuit part of the converter is housed in a sealed case of aluminium alloy together with an operating panel and an external cable connecting the terminal board.

The measuring circuit part serves to amplify and carry out computation based on the input (diffusion current and temperature compensating signal) from the detector, and to obtain output signals of 1 to 5 V DC or 4 to 20 mA DC, corresponding to the output range.

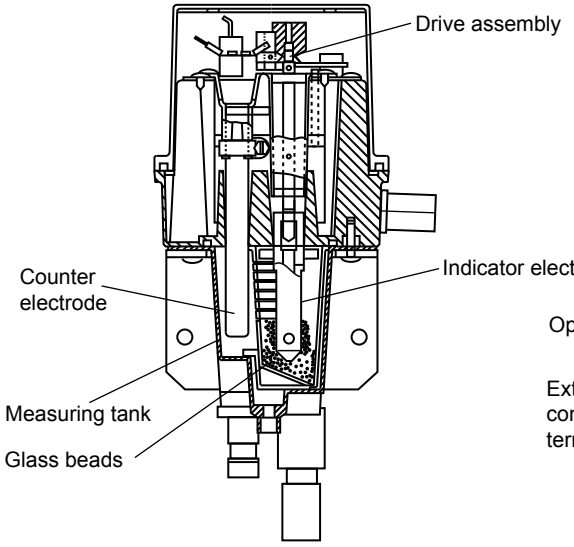


Figure 1.2 Detector

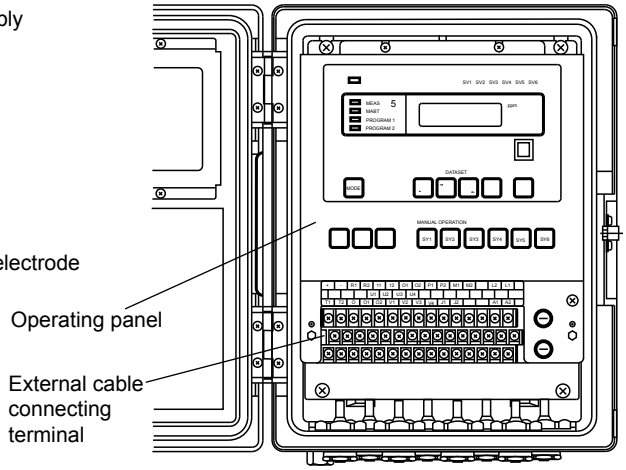


Figure 1.3 Converter

Sampling System

“Sampling System” consists primarily of sample water tubing and reagent tubing.

The system conditions the sample water and reagent fed to the measuring tank in the detector to a specified flow rate.
The sample tubing incorporates a ball valve, a head tank (for tap water) or a sand filter (for raw or treated water), and a metering pump.

The sand filter used for the raw and treated water analyzers serves to remove from sampled water flocks which contaminate electrodes and also iron and manganese ions that liberate iodine.

Another metering pump is incorporated in the reagent tubing to mix reagent from the reagent tank with the sample water being fed to the measuring tank at a constant flow rate.

Air Tubing System

The “air tubing system” consists of air purge tubing, etc.. The air purge tubing is provided for preventing the components of electrode drive assembly, the converter, pump drive assembly, etc. from corrosion due to halogen gases generated from the sample water.

When an air pump is included in the system, it supplies purging air. If no air pump is attached, connect the system through a regulating valve to a clean and dry air source like instrument air.

Cleaning Tubing System

The cleaning tubing system added to the raw treated water analyzers functions to clean filter sand in the sand filter, the measuring tank and glass beads, and to remove and drain flocks. Cleaning is automatically carried out by opening and closing the solenoid valve in cleaning water tubing with sequence signals from the converter. The cleaning water tubing is also provided with a regulating valve to adjust the cleaning water pressure.

Automatic Zero Calibration Tubing System

The residual chlorine analyzer with automatic zero calibration performs zero calibration using an activated charcoal filter. In the automatic zero calibration, the solenoid valve SV6 is opened and closed by a sequence signal from the converter.

1.2 Operating Principle of RC400G Residual Chlorine Analyzer

The measuring object of the RC400G residual Chlorine Analyzer is either free available chlorine or combined available chlorine.

Free available chlorine exists in the forms of chlorine (Cl_2), hypochlorous acid (HClO), or hypochlorite ion (ClO^-) in water. Combined available chlorine exists in the from of chloramines, such as trichloramine (NCl_3) and dichloramine ($NHCl_2$), generated through reactions of chlorine with ammonia nitrogen from contaminants in polluted rivers and other sources.

The residual chlorine analyzer operates on the principle of rotating electrode polarography. Measurement of free available chlorine content or total residual chlorine content including free and combined available chlorine contents can be performed by adequate selection of reagent, electrode and applied voltage.

For measurement of total residual chlorine, reaction of chlorine with sample water added with potassium iodide (KI) is implemented. Since KI is dissociated into K^+ and I^- in aqueous solution, the iodine equivalent to the amount of residual chlorine is liberated as shown in equations (1), (2), (3) and (4).

Free available chlorine

$$Cl_2 + 2I^- \rightarrow I_2 + 2Cl^- \quad \text{..... (1)}$$

Combined available chlorine

$$NH_2Cl \text{ (monochloramine)} + 2I^- + 2H^+ \rightarrow I_2 + NH_4Cl \quad \text{..... (2)}$$

$$NHCl_2 + 4I^- + 3H^+ \rightarrow 2I_2 + NH_4Cl + Cl^- \quad \text{..... (3)}$$

$$NCl_3 + 6I^- + 4H^+ \rightarrow 3I_2 + NH_4Cl + 2Cl^- \quad \text{..... (4)}$$

The iodine concentration (indirectly chlorine concentration) is determined by applying a voltage across the indicator and counter electrodes to conduct electrolytic reduction of the free iodine and simultaneously measuring the current.

Therefore, the voltage to be applied is selected as a value at which the so-called polarograph concentration polarization occurs, that is, current does not change when voltage changes. For measuring total residual chlorine, -0.40 V is applied.

The diffusion current observed under this condition is approx. 2.0 µA/mg/l in reference to the sample water at 20 °C and temperature coefficient is approx. 2.2 %/°C in the range of 0 to 40 °C.

The effect of temperature coefficient on measurement values is compensated by processing temperature signals from the temperature sensor (Pt 1000 Ω) built in the counter electrode.

In addition to potassium iodide, acetic acid and sodium acetate are added to the reagent to make the reagent act as a pH buffer. All the chlorine components are effectively detected by reducing the pH of sample water to 4.5 or below.

For measurement of free available chlorine content, potassium bromide (KBr) is added to sample water and bromine is liberated by reacting with chlorine as seen in equation (5).

$$Cl_2 + 2Br^- \rightarrow Br_2 + 2Cl^- \quad \text{..... (5)}$$

Except for the liberation of bromine, the measurement of free available chlorine is the same as the measurement of total residual chlorine.

Figure 1.4 illustrates the principle of the RC400G Residual Chlorine Analyzer.

The current flowing between the indicator (ME) and the counter (RE) electrodes is measured when a specific voltage is applied across the electrodes.

Temperature compensation is implemented through CPU computation based on temperature signals from the temperature-measuring circuit.

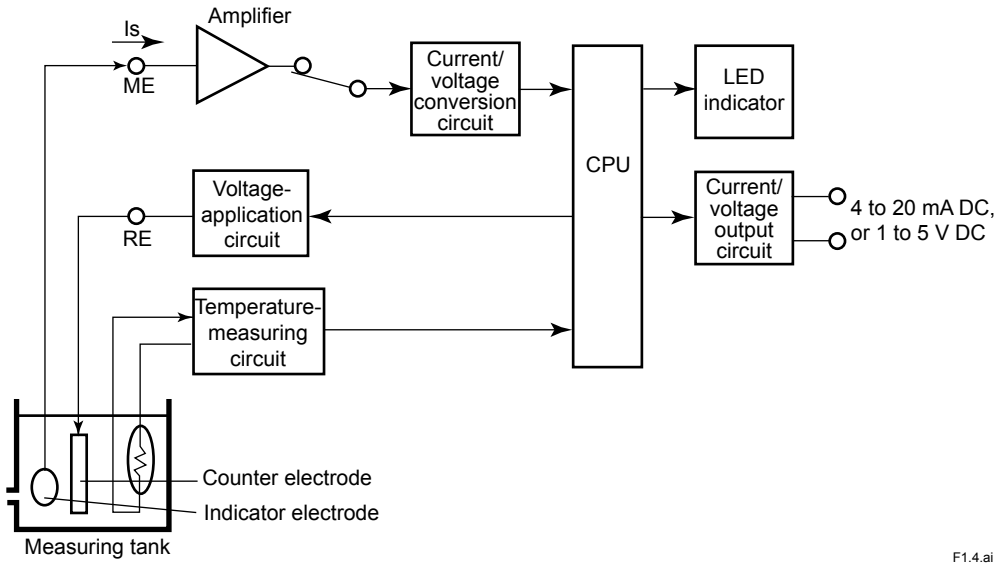


Figure 1.4 Schematic Diagram of Measuring Circuit

2. Specifications

In this chapter, specifications are given for the RC400G Residual Chlorine Analyzer, the RC401G Reagent Tank and others.

2.1 RC400G Residual Chlorine Analyzer

2.1.1 Standard specifications

■ Residual chlorine analyzer

Measurement object: Free chlorine or residual chlorine (total chlorine) in water

Measurement method: Rotating electrode type polarographic system

Measurement range: 0 to 10 mg/l (mg/l used as concentration units per JIS K0101 and municipal water test methods)

Output range: Can be freely set within ranges with spans of 1 mg/l or greater. (Range set when shipment. No.1: 0 to 5 mg/l No.2: 0 to 10 mg/l. Allows selection between 2 ranges (selected with contact input signal).
2-line-segment output available: Any desired point between 0% and 100% of measurement span can be set as the 50% point of the output range.

Output signal: 4 to 20 mA (load resistance, 550 Ω Max.) or 1 to 5 V DC (output resistance, 300 Ω Max.), isolated

Display range: -1.00 to 12.00 mg/l

Display method: Digital display (4-digit LED)

Output contacts: Voltage-free (“dry”) contacts

- Contact rating: Max. 250 V AC, Max. 2 A, Max. 125 VA (resistive load)
  Max. 220 V DC, Max. 2 A, Max. 60 W (resistive load)

Input contacts: Voltage-free (“dry”) contact

- ON resistance: 200 Ω Max.
- OFF resistance: 100 kΩ Min.
- Open circuit voltage: 10 V
- Closed circuit current: 100 mA

Automatic zero calibration: Zero calibration using activated charcoal filter (optional)

Contact inputs:

- Remote range switching: Switching between 2 preset ranges (range 1 and range 2)
  - Contact open: Range 1
  - Contact closed: Range 2

Contact outputs:

- FAIL contact: Activate when concentration over range, measurement temperature error, no liquid in flow cell converter error, temperature compensation over range, setting upper limit exceeded
- Range switching contact
- MAINT contact: Activate when analyzer is in maintenance mode

	Main power OFF	Main power ON	
	---	Not operating	Operating
FAIL contact	Open	Closed	Open
MAINT contact	Closed	Open	Closed

Sample conditions:

Temperature: 0 to 50 °C

pH: pH 3 to 9

Flow: 1 to 4 l/min, for pure water or municipal water application.
5 to 10 l/min, for raw water or sea water application.
10 to 20 l/min, for secondary sewage treatment application.

Pressure: 20 to 500 kPa

Electrodes:

Indicator electrode: Rotating gold alloy electrode

Counter electrode: Platinum electrode (built-in Pt1000 RTD), the combined chlorine insensitive version uses a silver chlorine electrode.

Reagents:

Composition: The following reagents are dissolved in pure water to give 100 l of solution.

(Note) Pure water should be equal to or exceed level of tap water and should not contain oxidizing and reducing substances such as chlorine.

	For residual chlorine measurement		For free chlorine measurement	For combined chlorine measurement
Maximum concentration	**Up to 6 mg/l**	**Over 6 up to 10 mg/l**	**Up to 10 mg/l**	**Up to 10 mg/l**
Potassium iodide, extra pure	500 g	1000 g	---	---
Potassium bromide, extra pure	---	---	4000 g	4000 g
Anhydrous sodium acetate, extra pure	150 g		1000 g	5400 g
Glacial acetic acid, extra pure	1000 ml		1000 ml	200 ml

Consumption: 1.5 ml/min ±10%

Constant flow pump:

Sample flow: 50 ml/min ±10%

Reagent flow: 1.5 ml/min ±10%

Converter functions:

Display functions:

Data: Concentration, temperature, applied voltage, diffusion current, output signal %, pump flow, zero point, slope

Status indicators: Measurement, maintenance, hold, calibration in progress, cleaning, fail

Operating status : Rotating gold alloy electrode, mertering pump, air pump, solenoid valve ON/OFF

Diagnostic functions: Concentration over range, measurement temperature error, no liquid in flow cell, converter error, temperature compensation over range, setting upper limit exceeded, zero point error, slope error, response error

Maintenance functions (MAINT mode):
One-touch calibration, flow cell and sand filter system cleaning, pump flow measurement, one-touch plateau characteristic acquisition, failure error information

Setup functions:

PROGRAM 1 mode
Output Range 1 and Range 2 settings, 2-line-segment output setting, applied voltage setting, response time and stability parameter settings, contact output during FAIL condition (ON/OFF), indication hold during MAINT (ON/OFF), remote range switching ON/OFF

PROGRAM 2 mode
Cleaning sequence setup, auto zero calibration sequence setup

Automatic cleaning functions: Electrode and flow cell cleaning methods

For pure water: Glass-bead cleaning

For raw/sea water, secondary sewage treatment:
Glass-bead cleaning+water jet cleaning;
Water jet cleaning flow: 2 to 3 l/min

Sand filter system:

Filter sand: Filter sand for municipal water (high-speed filtering sand, approx. 550 ml per tube)

Filtering flow: approx. 500 ml/min (per cylinder)

Backwash water flow: 8 to 9 l/min (per cylinder)

Standard cleaning sequence (factory settings)

	1-cylinder system	2-cylinder system	Setting range
Sand filter backwash interval	2 hours	30 min	0.1 to 24 h, 0.1 h steps
Sand filter backwash time	1 min	1 min	0.1 to 25 min, 0.1 min steps
Flow cell jet cleaning interval	2 hours	1 hour	0.1 to 24 h, 0.1 h steps
Flow cell jet cleaning time	1 min	1 min	0.1 to 25 min, 0.1 min steps
Waiting time	5 min	3 min	0.1 to 25 min, 0.1 min steps
Output hold time	6 min	4 min	Jet cleaning time + waiting time

In a 1-cylinder system, sand filter backwash and flow cell jet cleaning are performed at the same time.

Wetted part materials

Measurement tank: Acrylic resin

Pump: Fluorinated rubber (Viton), hardened PVC, SUS316

Tubing/piping: Polyethylene, hardened PVC

Stand materials: Carbon steel or stainless steel

Paint colors

Mounting stand: Munsell 0.6GY3.1/2.0

Other parts: Munsell 0.6GY3.1/2.0 and 2.5Y8.4/1.2

Finish: Baked polyurethane resin coating

Operating conditions

Ambient temperature: -5 to 55 °C (However, measure to prevent freezing are required if the water sample or reagent appears to freeze.)

Ambient humidity: 5 to 95% RH (non-condensing)

Storage temperature: -30 to 70 °C

Installation: Indoors (A separate rainproof cover is required for outdoor installation. Avoid direct sunlight.)

Utilities

Power supply: 100/110/220 V AC ±10%, 50/60 Hz

Power consumption:

RC400G-1☐: Approx. 65 VA

RC400G-2☐: Approx. 125 VA

RC400G-3☐: Approx. 210 VA

Cleaning water (required with sand filter system)

Quality: clean water

Pressure: 100 to 500 kPa

Flow: 10 to 12 l/min

Consumption: Approx. 130 l/day (1-cylinder sand filter type)
Approx. 470 l/day (2-cylinder sand filter type)
(With standard cleaning sequence [factory settings])

Air purge (using instrument air)

Supply pressure: 140 kPa
Air consumption: Approx. 5 l/min

Weight

For pure water: Approx. 65 kg
For raw water (1-cylinder): Approx. 70 kg
For raw water (2-cylinder): Approx. 75 kg

Optional specifications

Pump for air purge (if instrument air cannot be used)
Install to enable intake of clean air.

Intake/discharge: 5 l/min, at 50 Hz (Intake/discharge outlets: Open)
Maximum pressure: 80 kPa
Power consumption: Approx. 23 VA
Weight: Approx. 2 kg

Regulatory Compliance:

EMC Regulatory Arrangement in Australia and New Zealand (RCM)
EN 55011 Class A, Group 1
Korea Electromagnetic Conformity Standard Class A 한국 전자파적합성 기준

A급 기기 (업무용 방송통신기자재)
이 기기는 업무용(A급) 전자파적합기기로서 판매자 또는 사용자는 이 점을 주의하시기 바라며, 가정외의 지역에서 사용하는 것을 목적으로 합니다.

Reagent sets (for one year)

For free chlorine

Potassium bromide extra pure: 64 containers, 500 g each
Anhydrous sodium acetate extra pure: 16 containers, 500 g each
Acetic acid extra pure: 17 containers, 500 ml each

For residual chlorine (Total chlorine)

Potassium iodide extra pure: 8 containers, 500 g each
Anhydrous sodium acetate extra pure: 3 containers, 500 g each
Acetic acid extra pure: 17 containers, 500 ml each

For high concentration of residual chlorine (Total chlorine)

Potassium iodide extra pure: 16 containers, 500 g each
Anhydrous sodium acetate extra pure: 3 containers, 500 g each
Acetic acid extra pure: 17 containers, 500 ml each

For combined chlorine insensitive version (Free chlorine)

Potassium bromide extra pure: 64 containers, 500 g each
Anhydrous sodium acetate extra pure: 87 containers, 500 g each
Acetic acid extra pure: 4 containers, 500 ml each

(Note) These reagents sets are not imported from Japan because of both safety and transportation cost issues. Purchase them directly in your local reagent supplier.

2.1.2 Characteristics

(Percent display is computed with respect to whichever of output range 1 or output range 2 has the highest upper range value)

Repeatability: 2%

Linearity: ±3%

Drift:

Zero drift: ±1%/month Max.

Span drift: -5%/month Max.

Response time: Displayed as 90% response time

For pure water: Approx. 3 min

For raw water: Approx. 4 min (Within 3 min from standard liquid inlet)

Temperature compensation error (water temperature):

±1% Max. (Temperature compensation range: 0 to 40 °C)

Effect of ambient temperature: ±0.5%/10 °C

Effect of power variation: ±0.5%/10% of rated voltage

Effect of combined chlorine: 5% or less, of concentration of combined chlorine for combined chlorine insensitive version

2.1.3 Accessories

● Residual chlorine meter

Name	Quantity	Remark
Polishing powder	1 bottle	For polishing electrode
Lubricating oil	1	For metering pump drive
Fuses	4 each	1 A and 3 A (for spare)
Glass beads	1	(including for spare) (2 bags)
Valve sheet	4	For pump (for spare)
Bellofram	1	For sample pump (for spare)
	1	For reagent pump (for spare)
Special tool	1	For pump valve replacement
Tool	1	For Bellofram replacement
Allen wrenches	1 set	1.5, 2, 2.5, 4, 5, 6 (mm)
Reagent set	(*)	For startup

(*) These reagents sets are not imported from Japan because of both safety and transportation cost issues. Purchase them directly in your local reagent supplier.

2.1.4 Product model and suffix codes

● Residual chlorine analyzer

[Style: S3]

Model	Suffix code	Option code	Description
RC400G	----------	----------	Residual chlorine analyzer
Application (cleaning unit) (*1)	-1	----------	For pure water, for municipal water (with glass-bead cleaning)
	-2	----------	For raw water (1-cylinder) (with glass-beads cleaning, jet cleaning, and one cylinder sand filter unit) (*6)
	-3	----------	For raw water (2-cylinder) (with glass-beads cleaning, jet cleaning, and two cylinder sand filter unit) (*6)
Output signal	5	----------	1 to 5 V DC
	6	----------	4 to 20 mA DC
Power supply	1	----------	200 V AC, 50 Hz
	2	----------	200 V AC, 60 Hz
	3	----------	220 V AC, 50 Hz
	4	----------	220 V AC, 60 Hz
	5	----------	100 V AC, 50 Hz
	6	----------	100 V AC, 60 Hz
	7	----------	110 V AC, 50 Hz
	8	----------	110 V AC, 60 Hz
Measurement object (*2)	F	----------	Free chlorine
	T	----------	Residual chlorine (total chlorine)
	C	----------	Combined chlorine insensitive version (free chlorine) (*3)
-	-N	----------	Always -N
-	*A	----------	Always A
Optional specifications		/AP1	With air purge pump (200 V AC, 50/60 Hz) (*7)
		/AP3	With air purge pump (220 V AC, 50/60 Hz) (*7)
		/AP5	With air purge pump (100 V AC, 50/60 Hz) (*7)
		/AP7	With air purge pump (110 V AC, 50/60 Hz) (*7)
		/PPM	Units: ppm
		/NR	Without reagent set for start-up (*4)
		/SCT	Stainless tag plate
		/S	Stainless stand (*5)
		/AZC	With automatic zero calibration
		/ARS	With arrestor (power and signal lines)

*1: "Application" indicates general guidelines. Select the cleaning equipment appropriate for the contamination in the sample.
*2: Measurement object selection is indicated in the following.
*3: Less affected by combined chlorine in free chlorine measurement.
*4: When ordering the RC400G, select /NR and get reagent sets for start-up from local reagent supplier. These reagent sets can not be exported from Japan due to both safety and transportation issues.
*5: Stanchion, base and bracket are stainless steel.
*6: Please contact Yokogawa regarding the adequate number of the cylinder.
*7: Installation of air purge is always required for all application. If instrument air cannot be used, select the air purge pump.

Application	Measurement object	
	Free chlorine	Total chlorine
Water purification: raw water	○ (*1)	○
Water purification: mixed water, sedimentation water	○ (*1)	○
Water purification: mains water	○	○
Sea water	x	x (*3)
Factory wastewater, treated effluent	x	x
Factory cooling water (industrial water)	x	○ (*2)
Factory drinking water	○	○
Sewage secondary treatment	x	x (*3)

○: Can be measured x: Cannot be measured
*1: If ammoniacal contaminants are present in large quantity, high concentrations of combined chlorine may remain if sampling is performed soon after chlorine injection in prechlorination treatment, or in intermediate treatment without prechlorination treatment. In this case, combined chlorine type is recommended
*2: Oxidizing or reducing agents other than chlorine may be present. If so, chlorine concentration measurement may not be possible.
*3: There are Residual chlorine analyzer for sewage secondary treatment or sea water. Please ask.

● Spare parts

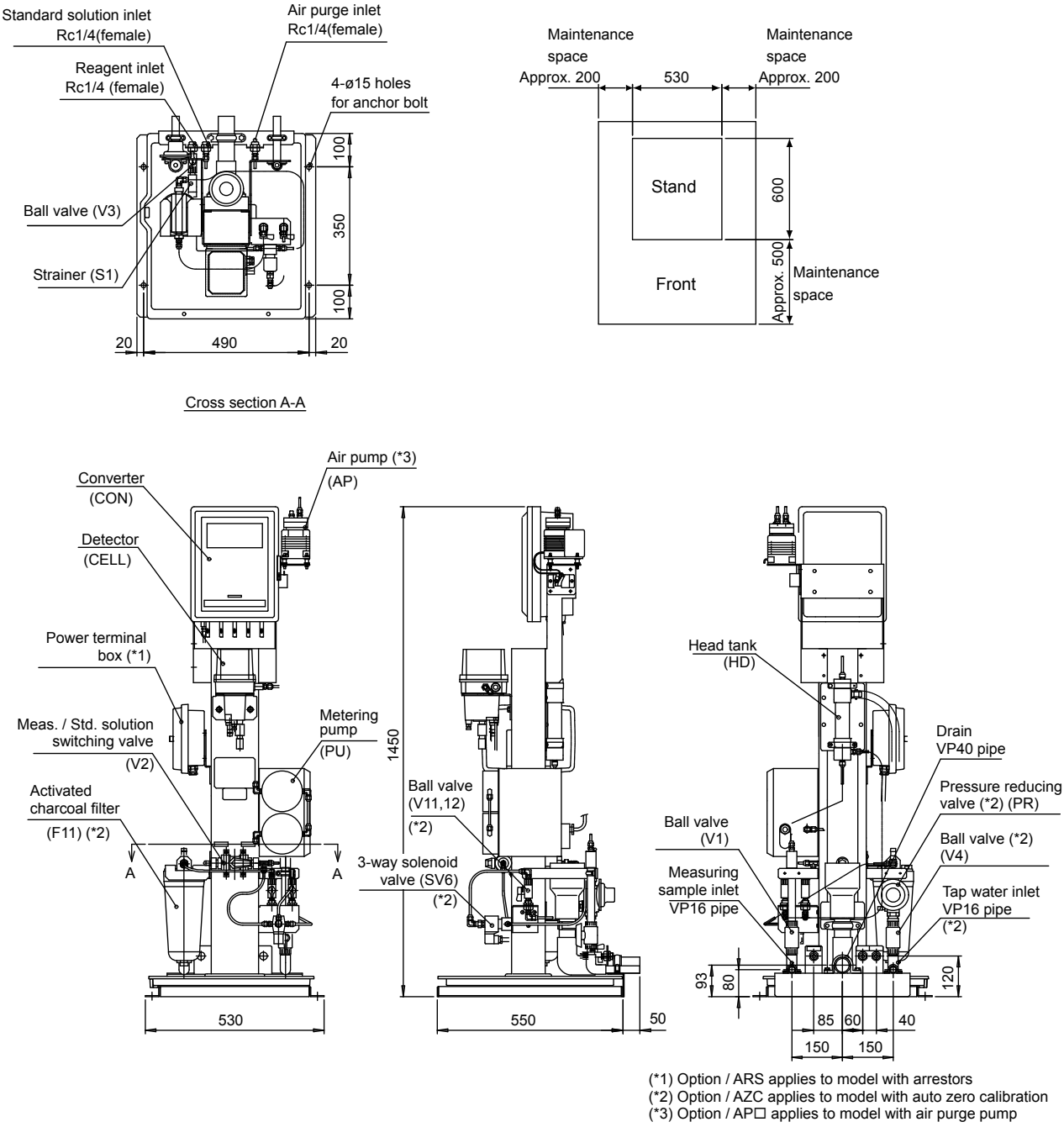
Name	Part No.	Description	Q'ty	Recommended replacement interval (*1)
Indicator electrode (Rotating electrode)	K9334JP	Gold alloy electrode (*4)	1	Yearly
Counter electrode	K9332MJ	Reference electrode	1	(*2)
Counter electrode	K9332MK	For combined chlorine insensitive type	1	(*2)
Glass beads	K9332ZJ	For cleaning indicator electrode. (2 bags/Q'ty)	1	Yearly
Polishing powder (Alumina)	K9088PE	For polishing indicator electrode	1	-
Brush	K9332JX	Part for electrode mechanism	1	2 years
Slip ring	K9332JZ	Part for electrode mechanism	1	2 years
Drive belt	L9804UK	Part for electrode mechanism	1	3 years
Driven shaft assembly	K9334JV	Part for electrode mechanism (*4)	1	3 years
O-ring	Y9115XB	Part for electrode mechanism	1	3 years
Motor assembly (100 V)	K9334JY	Part for electrode mechanism	1	3 years
Motor assembly (110 V)	K9334VQ	Part for electrode mechanism	1	3 years
Motor assembly (200 V)	K9334VR	Part for electrode mechanism	1	3 years
Motor assembly (220 V)	K9334VS	Part for electrode mechanism	1	3 years
Gear head (100 V / 110 V)	K9332JP	Part for electrode mechanism	1	3 years
Gear head (200 V/220 V)	K9334VA	Part for electrode mechanism	1	3 years
Fuse (1 A)	A1109EF	For electric circuit	1	Yearly (*5)
Fuse (3A)	A1113EF	For power supply	1	Yearly (*5)
Sand	K9720FZ	For sand filter unit (1liter)	1	yearly
Air pump (100 V)	K9087XA	For air purgepump	1	3 years
Air pump (110 V)	K9087XF	For air purgepump	1	3 years
Air pump (200 V)	K9087XG	For air purgepump	1	3 years
Air pump (220 V)	K9087XH	For air purgepump	1	3 years
Lubricating oil (engine oil)	K9041RA	For metering pump drive	1	1 month (*3)
Bellofram	L9819AA	For reagent pump	1	6 months
Bellopfram	L9819AB	For sample water pump	1	6 months
Valve sheet	K9041HC	For metering pump	1	6 months
Activated charcoal filter	L9862AY	For automatic zero calibration	1	Yearly
Filter	K9332NN	For head tank or sand filter	1	Yearly

(*1) Replacement intervals vary depending on the application. (*2) At the time of damage
(*3) 30 ml, for lubricating the metering pump drive assembly (*4) P/N changed by style S3.
(*5) Fuse may be used more than one year, we recommend periodical replace for planning maintenance.

2.1.5 Flow diagrams and outline drawings

RC400G-1 Residual chlorine analyzer for tap water

unit : mm



(*1) Option / ARS applies to model with arrestors
(*2) Option / AZC applies to model with auto zero calibration
(*3) Option / AP☐ applies to model with air purge pump

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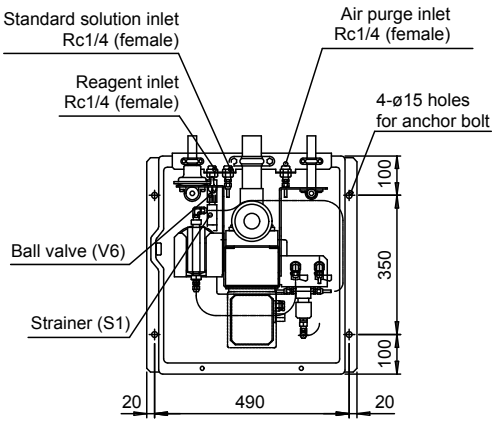
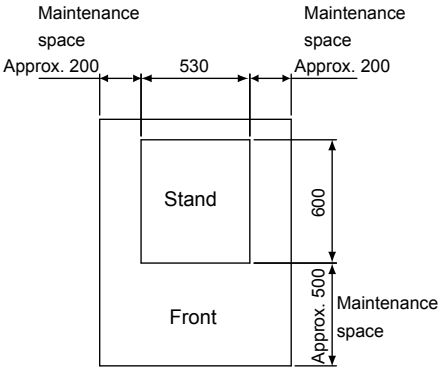
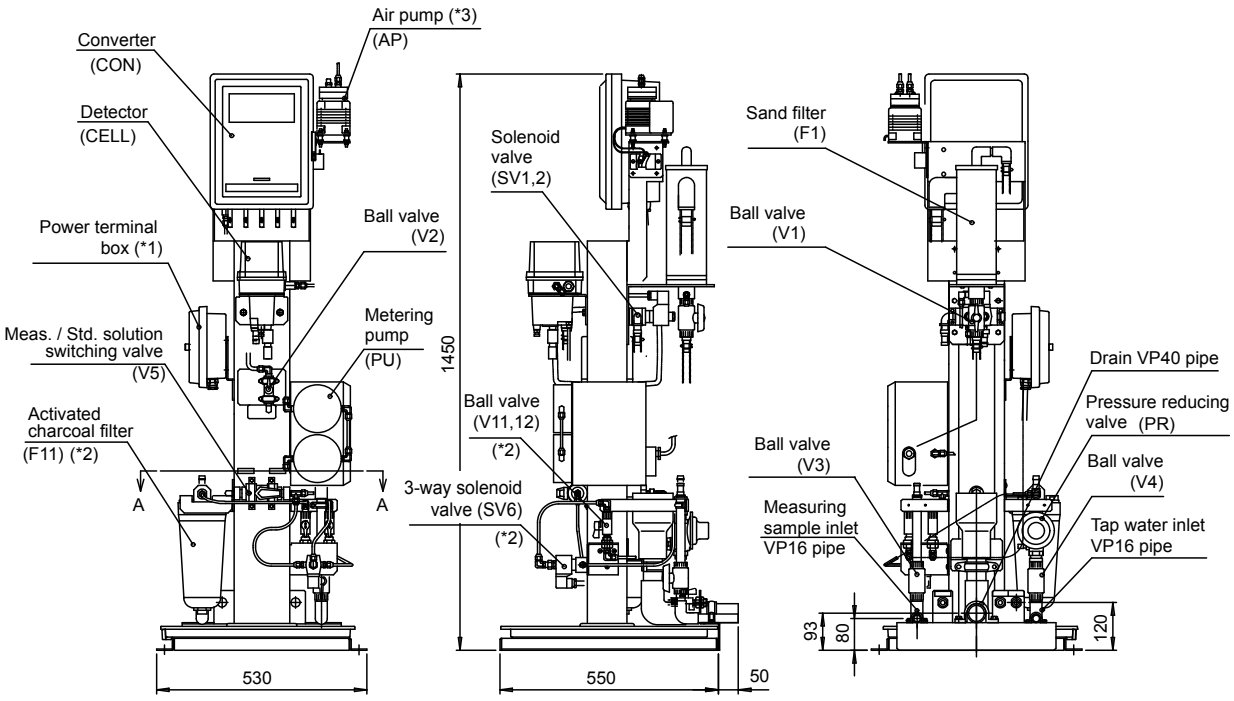
RC400G-2 Residual chlorine analyzer for raw water with one cylinder sand filter unit

unit : mm



Cross section A-A





(*1) Option / ARS applies to model with arrestors
(*2) Option /AZC applies to model with auto zero calibration
(*3) Option / AP☐ applies to model with air purge pump

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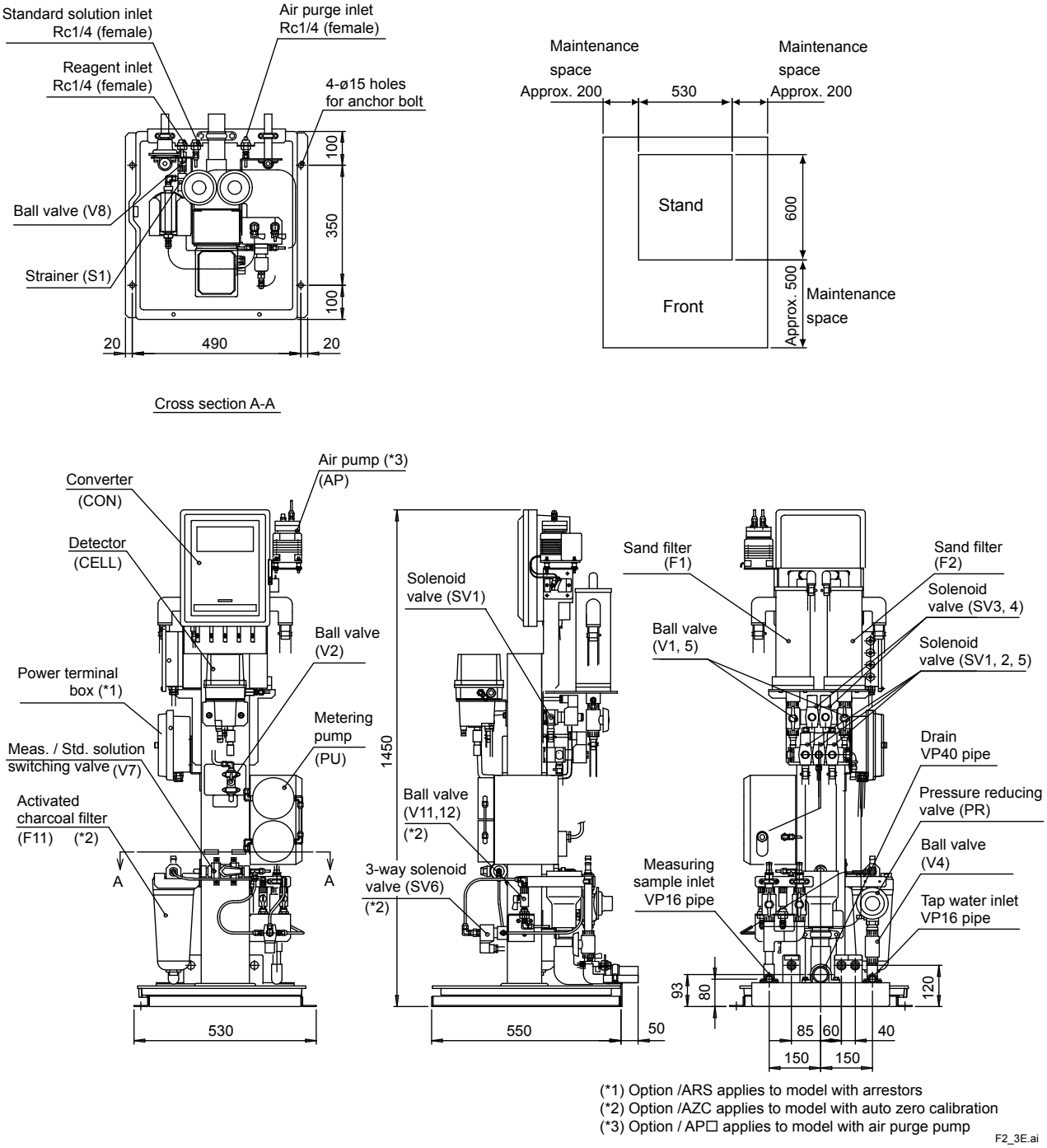
RC400G-3 Residual chlorine analyzer for treated water with two cylinder sand filter unit

unit : mm



(*1) Option /ARS applies to model with arrestors
(*2) Option /AZC applies to model with auto zero calibration
(*3) Option / AP☐ applies to model with air purge pump

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2.2 RC401G Reagent Tank

It is a tank to hold reagent to be supplied to the residual chlorine analyzer. It is equipped with a stirrer (manual) and a level gauge.

Either a tank only or a tank installed on a stand are available.

NOTE

When the tank with a stand (RC401G-B) is used, open a needle valve gradually and stop it at the position when reagent starts to flow. Don't open more, otherwise leakage may happen.

2.2.1 Standard specifications

(1) Reagent tank (RC401G-A)

Capacity: 100 l

Materials: Rigid PVC

Weight: Approx. 15 kg

Other: With manual mixer, and level gauge

(2) Reagent tank with stand (RC401G-B)

Incorporates the reagent tank in item (1) with a stand and a needle valve.

Materials: Carbon steel

Stand color: Munsell 2.5Y8.4/1.2

Stand finish: Baked polyurethane resin coating

Weight: Approx. 25 kg

(3) Reagent mixing tank with cart (RC401G-C)

This is a tank to prepare reagent. It is mounted on a cart and provided with a manual stirrer and a pump to transfer the prepared reagent to the reagent tank (RC401G). The pump is driven by 100 V AC.
A reagent mixing tank mounted on a cart. With manual mixer, and pump for transferring reagents.
Note: This tank is for reagent mixing, and is not a substitute for the reagent tank.

Tank capacity: 100 L

Tank materials: Rigid PVC

Cart materials:

Frame: Steel pipe (SPG30A)

Bracket: Steel plate (SPCC)

Pump (Seal-less Pump)

Discharge flow rate: 14 to 35 L/min

Wetted part material: Polypropylene resin, Hastelloy, ceramics, fluorinated rubber

Power supply: 100 V AC, 50/60 Hz

Power consumption: Approx. 100 VA

Power cord: PVC sheathed cable, 5 m

Weight: Approx. 40 kg

2.2.2 Product model and suffix codes

Model	Suffix code	Option code	Description
RC401G	----------	----------	Reagent tank
Type	-A	----------	Reagent tank only
	-B	----------	Reagent tank with stand
	-C	----------	Reagent mixing tank with mobile stand
-	-HM	----------	With manual mixer
-	*A	----------	Style A

2.2.3 Accessories

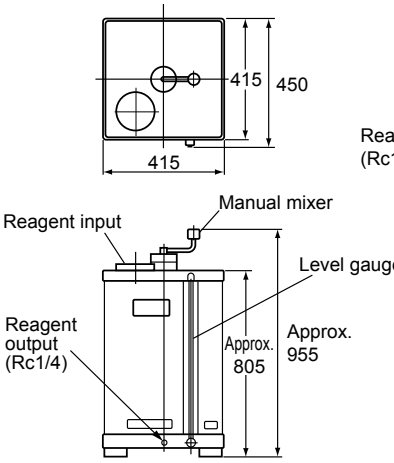
- **Reagent tank (RC401G-A, RC401G-B)**

Name	Quantity	Remark
Couplings	2 sets	
Polyethylene tubing	5 m	Outside diameter 6 mm, Inside diameter 4 mm.

Note: These are not included in reagent mising tank (RC401G-C).

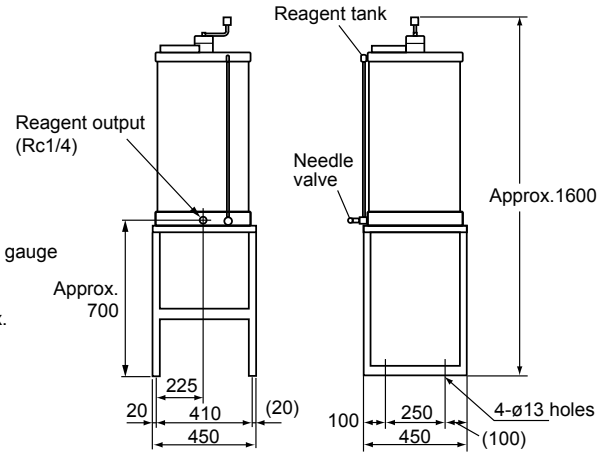
2.2.4 Outline drawings

● RC401G-A

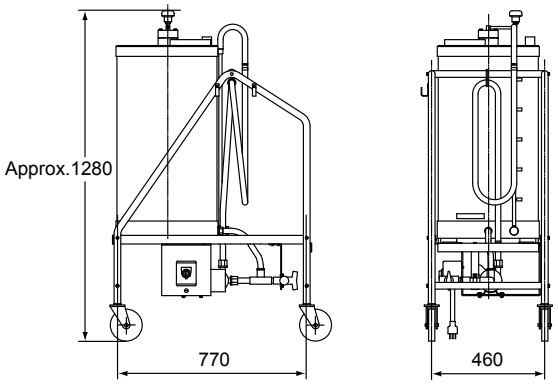


● RC401G-B

Unit: mm



● RC401G-C



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3. Installation, Tubing and Wiring

Instructions for installation, tubing and wiring of the RC400G Residual Chlorine Analyzer are given in this chapter.

When transferring the RC400G from storage or in unpacking it, observe the caution in the foreword in the early part of this user's manual.

3.1 Installation

3.1.1 Location

Install the RC400G analyzer in a location to satisfying the following conditions.

- A building or a cabinet free rain water.
- Slight vibration
- Substantially free from corrosive gases.
- Low humidity.
- Slight temperature variation. Ambient temperature should be approximately maintainable near ordinary temperatures.
- Sufficient and accessible space for maintenance.
- Provision for drainage.

3.1.2 Installation

Securely fix the analyzer to a well-drained concrete foundation or the equivalent.

NOTE

Refer to the external dimension figures in Chapter 2 for the position of anchor bolting, etc..

When using "RC401G-A Reagent Tank" for supplying reagent to the analyzer, install the tank in such a manner that its bottom is positioned about 70 cm above the floor surface where the analyzer is installed.

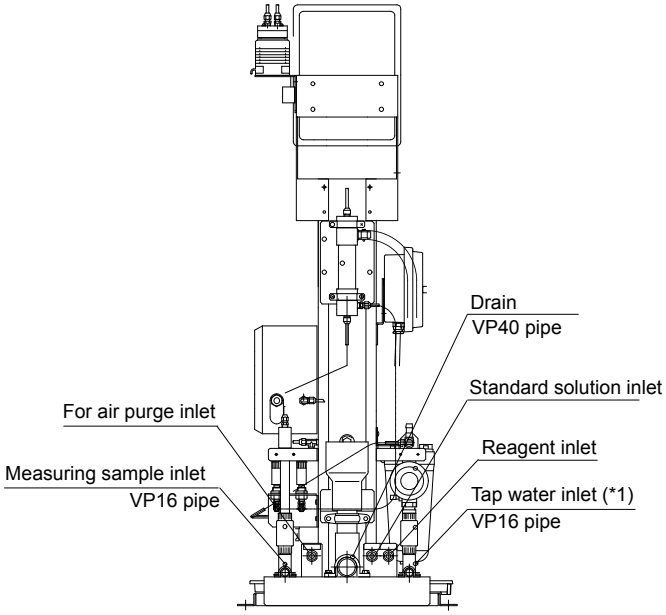
3.2 Tubing

Tubing for the analyzer include the following:

(1) Sample water tubing [see subsection 3.2.1]
(2) Reagent tubing [see subsection 3.2.2]
(3) Washing water tubing (for raw or treated water type analyzers) [see subsection 3.2.3]
(4) Drain tubing [see subsection 3.2.4]
(5) Purge air tubing (when the analyzer is not provided with air pump) [see subsection 3.2.5]
(6) Standard solution tubing (for calibration) [see subsection 3.2.6]
(7) Automatic zero calibration tubing [see subsection 3.2.7]

Tubing connections and flow charts for the RC400G-1, RC400G-2 and RC400G-3 are illustrated in Figure 3.1.1 to 3.1.3, Figure 3.2.1 to 3.2.3 and Figure 3.3.1 to 3.3.3, respectively.

(1) RC400G-1 Residual Chlorine Analyzer for Tap Water



(*1) Option /AZC applies to model with auto zero calibration

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Figure 3.1.1 Piping of RC400G-1 Residual Chlorine Analyzer for Tap Water

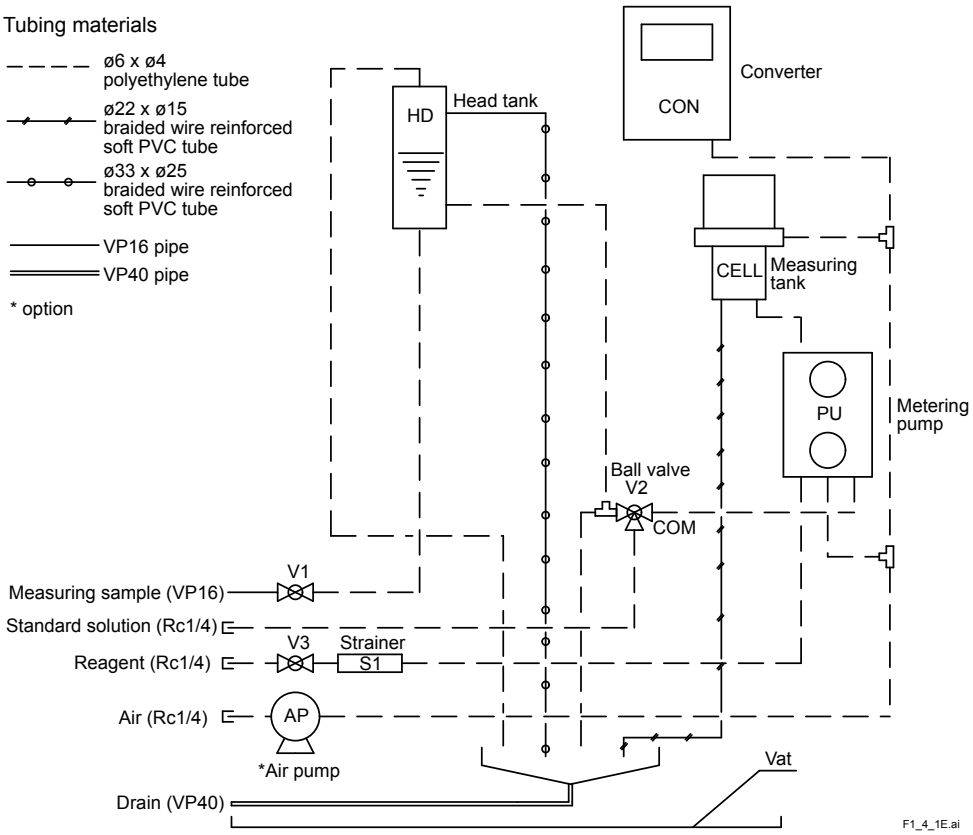


Figure 3.1.2 Tubing Diagram of RC400G-1

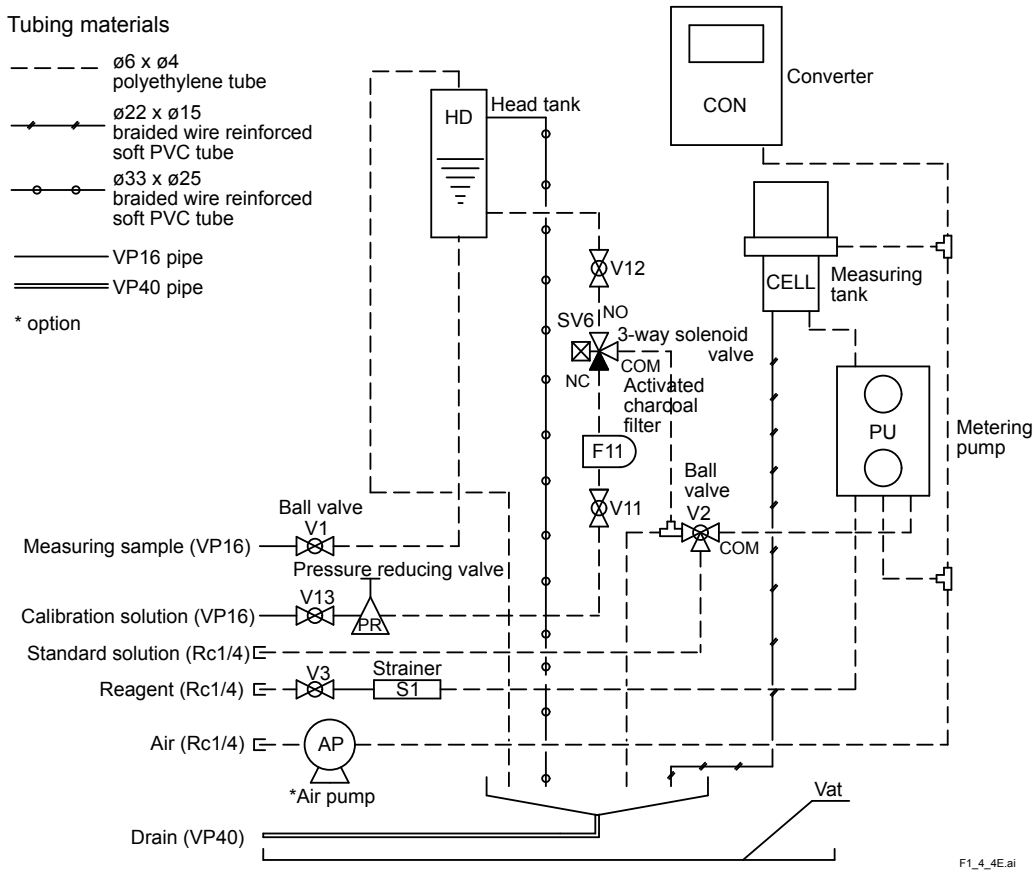


Figure 3.1.3 Tubing Diagram RC400G-1/AZC

(2) RC400G-2 Residual Chlorine Analyzer for Raw Water

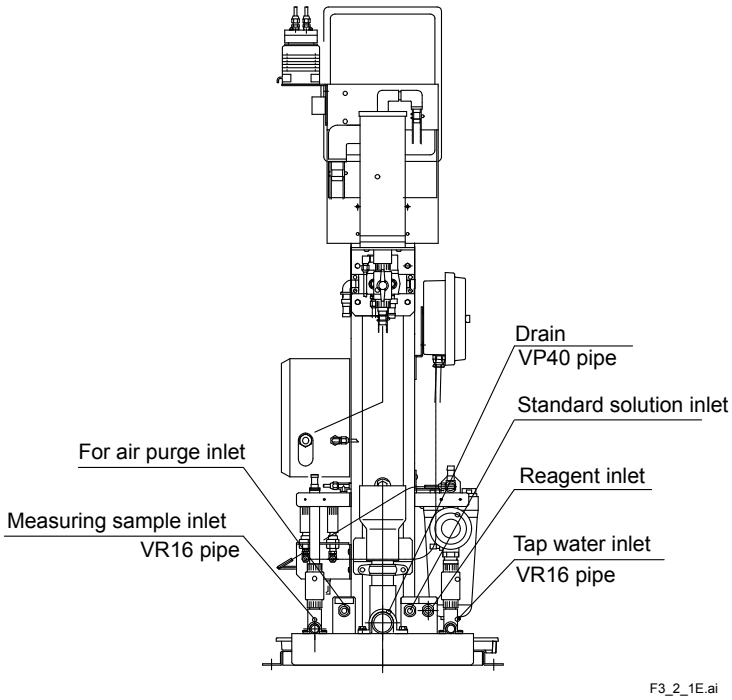


Figure 3.2.1 Piping of RC400G-2 Residual Chlorine Analyzer for Raw Water

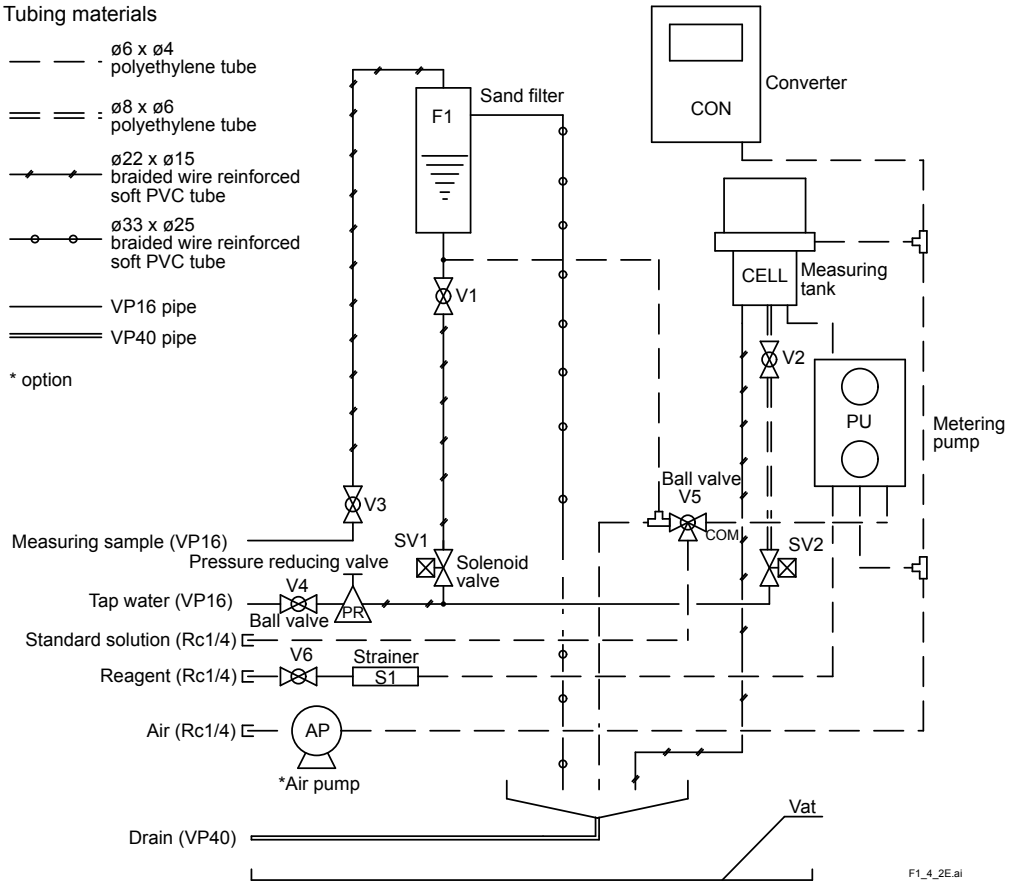


Figure 3.2.2 Tubing Diagram of RC400G-2

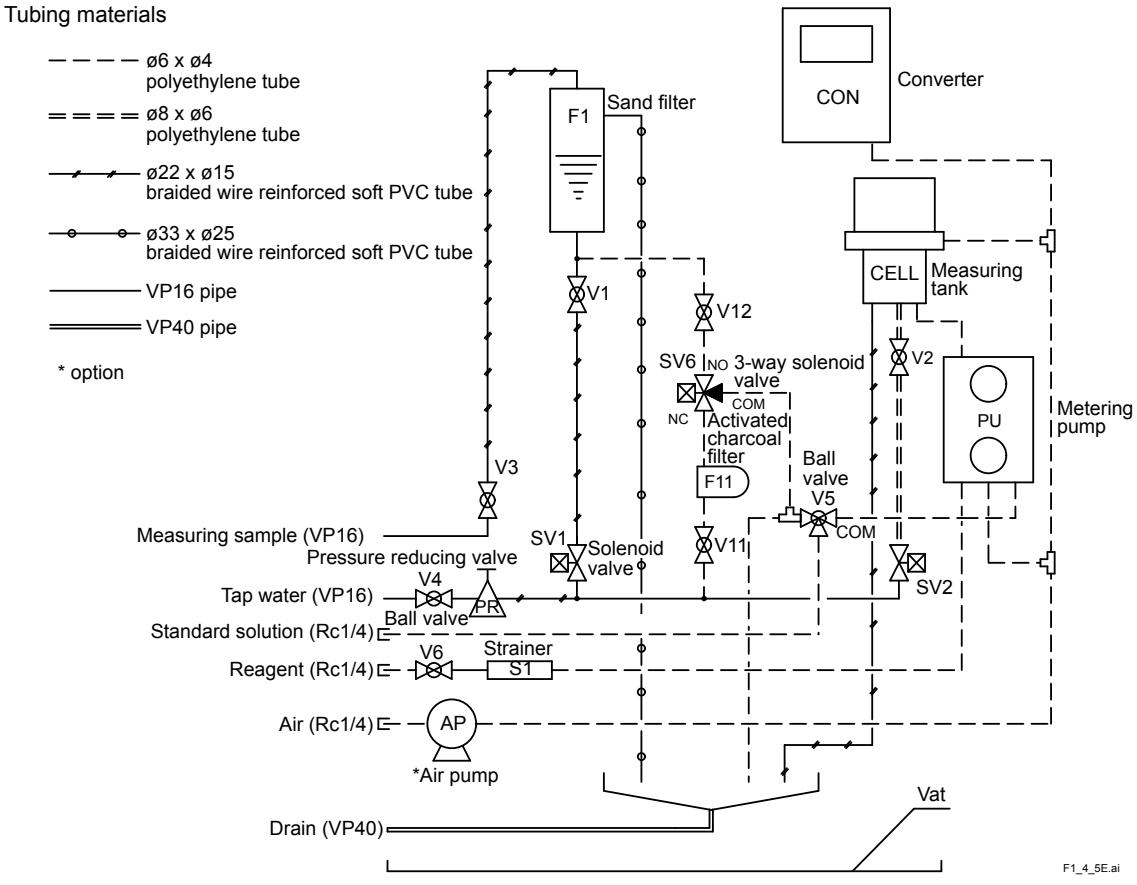


Figure 3.2.3 Tubing Diagram of RC400G-2/AZC

(3) RC400G-3 Residual Chlorine Analyzer for Treated Water

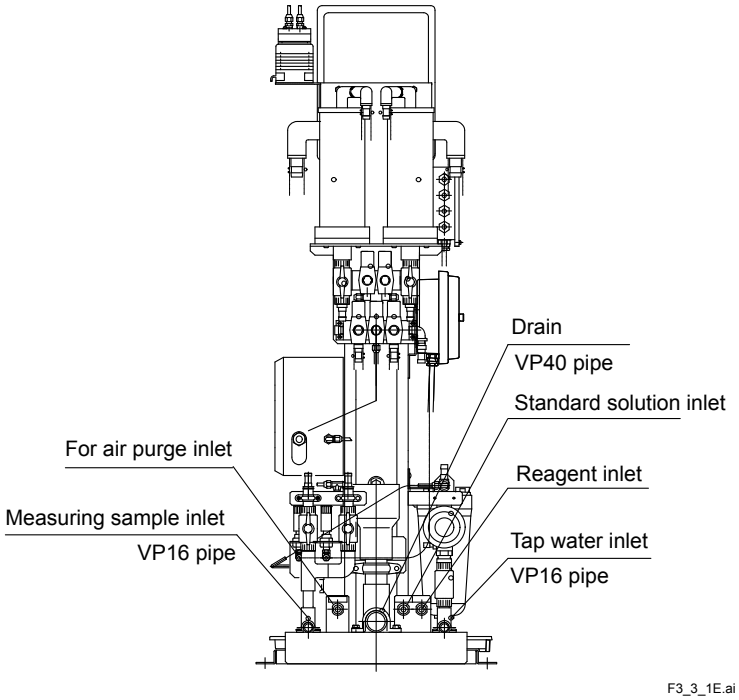


Figure 3.3.1 Piping of RC400G-3 Residual Chlorine Analyzer for Treated Water

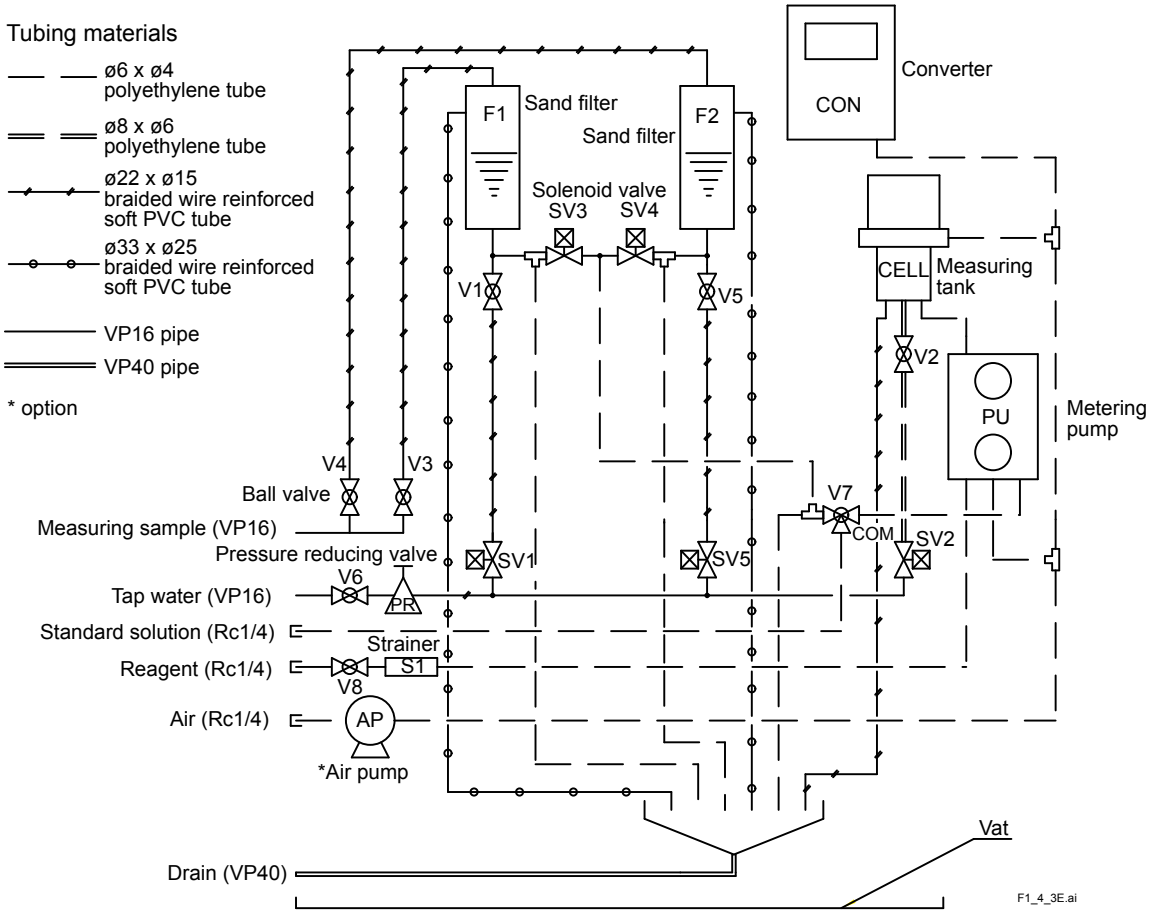


Figure 3.3.2 Tubing Diagram of RC400G-3

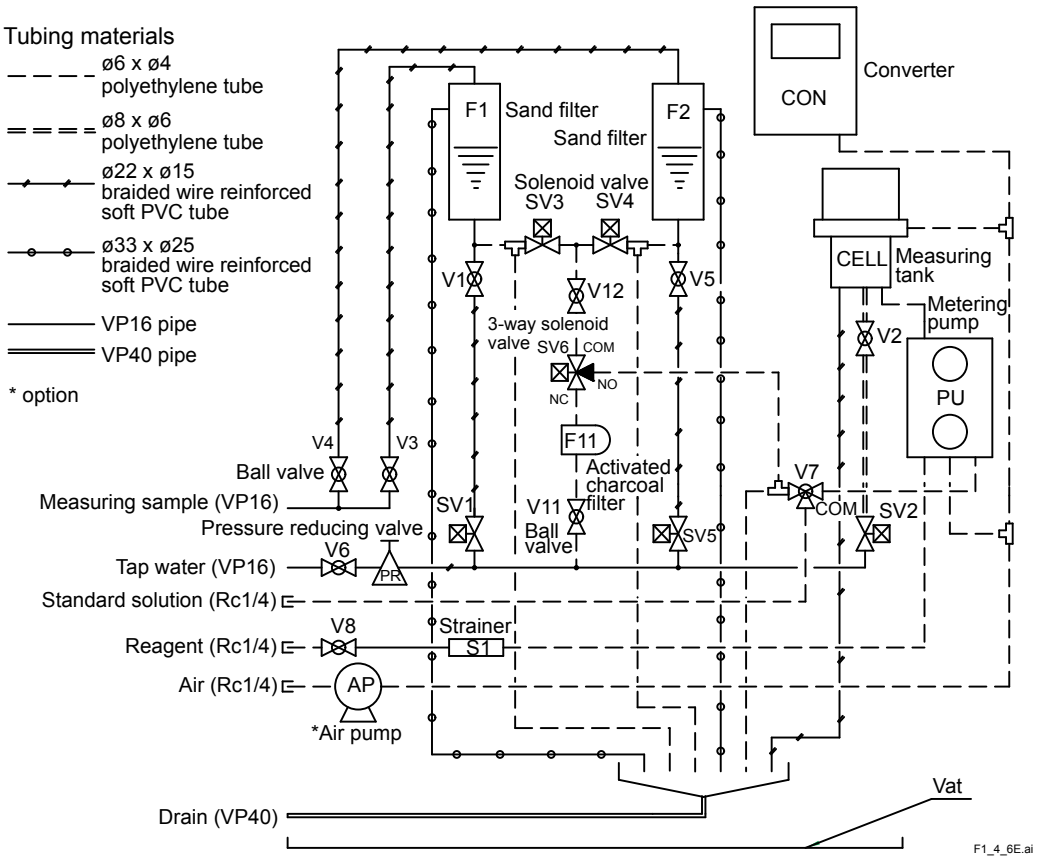


Figure 3.3.3 Tubing Diagram of RC400G-3/AZC

3.2.1 Sample Water Tubing

This is the tubing for taking sample water and feeding it to the analyzer.

The connection is a rigid PVC tube of nominal dia. 16 (O.D. 22 mm). Implement tubing using proper joints, i.e. unions and flanges etc., which fit the connection. Note: Perform tubing so that sample water pressure at the connection falls within the range of 20 to 500 kPa.

Sample water flow rates to the analyzer in operation are as follows:

In RC400G-1: 1 to 4 l/min
In RC400G-2: 5 to 10 l/min
In RC400G-3: 10 to 20 l/min

3.2.2 Reagent Tubing

Residual chlorine content is determined by sample water mixed with reagent. The reagent tubing supplies reagent to the measuring cell of the analyzer.

Connect the outlet of the reagent tank to the reagent inlet of the analyzer using Rc1/4 joint and O.D. 6 mm x I.D. 4 mm polyethylene tube.

There is a reagent level limit in the tank.

Check that the position of the reagent tank is in accordance with Figure 2.4 RC401G Reagent Tank.

3.2.3 Cleaning Water Tubing

This tubing is required for the raw water type and treated water type analyzers.

In these types of analyzers, intake sample water is filtered by the sand filter. For maintaining filtering capacity, the sand filter is flushed with water at regular intervals to remove floccules, etc. deposited in the filter.

The cleaning water tubing leads tap water for washing to the analyzer.

The connection is a rigid PVC tube of nominal dia. 16 (O.D. 22 mm).

Perform tubing in the same manner as the sample water tubing, using proper joints, so as to allow cleaning water pressure to fall within the range of 100 to 500 kPa.

3.2.4 Drain Tubing

This is the tubing to discharge sample water and cleaning water from the analyzer to a drainage ditch, etc..

The specifications of the tubing connections are given below.

In RC400G-1: Rigid PVC tube, nominal dia. 40 (O.D. 48 mm)
In RC400G-2: Rigid PVC tube, nominal dia. 40 (O.D. 48 mm)
In RC400G-3: Rigid PVC tube, nominal dia. 40 (O.D. 48 mm)

Perform tubing so as to prevent sedimentation and formation of any dead spot in the tubing.

3.2.5 Purge Air Tubing

This is the tubing to supply clean dry air to the cases which house the converter, electrode mechanism block and pump drive assembly for air purging.

When the RC400G is provided with an air pump, extend the tubing to an area free from corrosive gases for intake of clean air. If an air pump is not available, employ instrument air, etc. and perform tubing so that air is supplied at a pressure of approx. 140 kPa.

The connection is Rc1/4.

3.2.6 Standard Solution Tubing

This supplies standard solution to the analyzer for calibrating zero point or span.

Usually, this tubing is set up every time when calibration (refer to Chapter 7) is conducted.

The tubing connection is Rc1/4.

NOTE

Standard solution supplied from the tubing connection is directly fed to the metering pump. If the pressure of the supplied standard solution largely exceeds 10 kPa, standard solution may enter the reagent line or some quantity of solution more than specified may be sent to the detector causing the measuring cell to overflow. As a rule, standard solution should be supplied only in the manner described in Chapter 7.

3.2.7 Automatic Zero Calibration Tubing

This is the tubing that is used when zero calibration using an activated charcoal filter is performed. If the option has been specified, this tubing is installed at the factory before shipment.

3.3 Wiring

The type of wiring required by the residual chlorine analyzer are as shown below. All are connected to wiring terminals (M4 screw) in the converter. When the analyzer with arrestors, connect terminals of power and analog output to the terminal box.

(1) Wiring for power supply and grounding.

(2) Wiring for analog output signals.

(3) Wiring for contact input (<remote> range switching).

(4) Wiring for contact output (<maintenance>, <failure>). (when required)

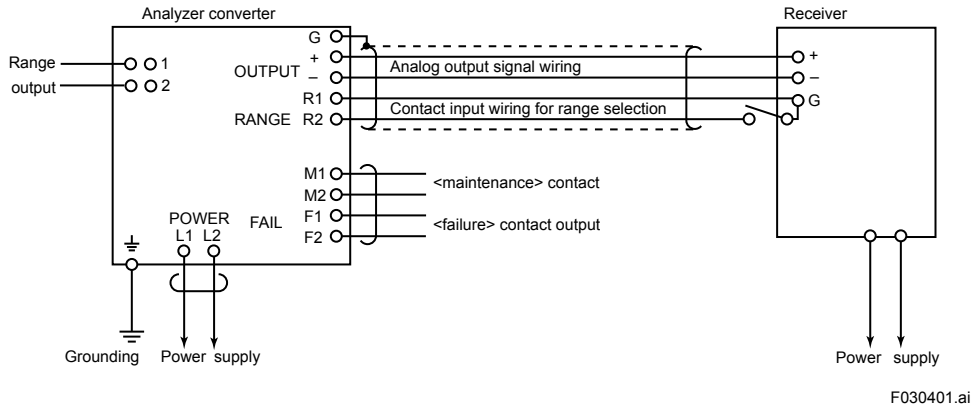


Figure 3.4 External Wiring Diagram

RC400G-1 Residual Chlorine Analyzer for Tap Water

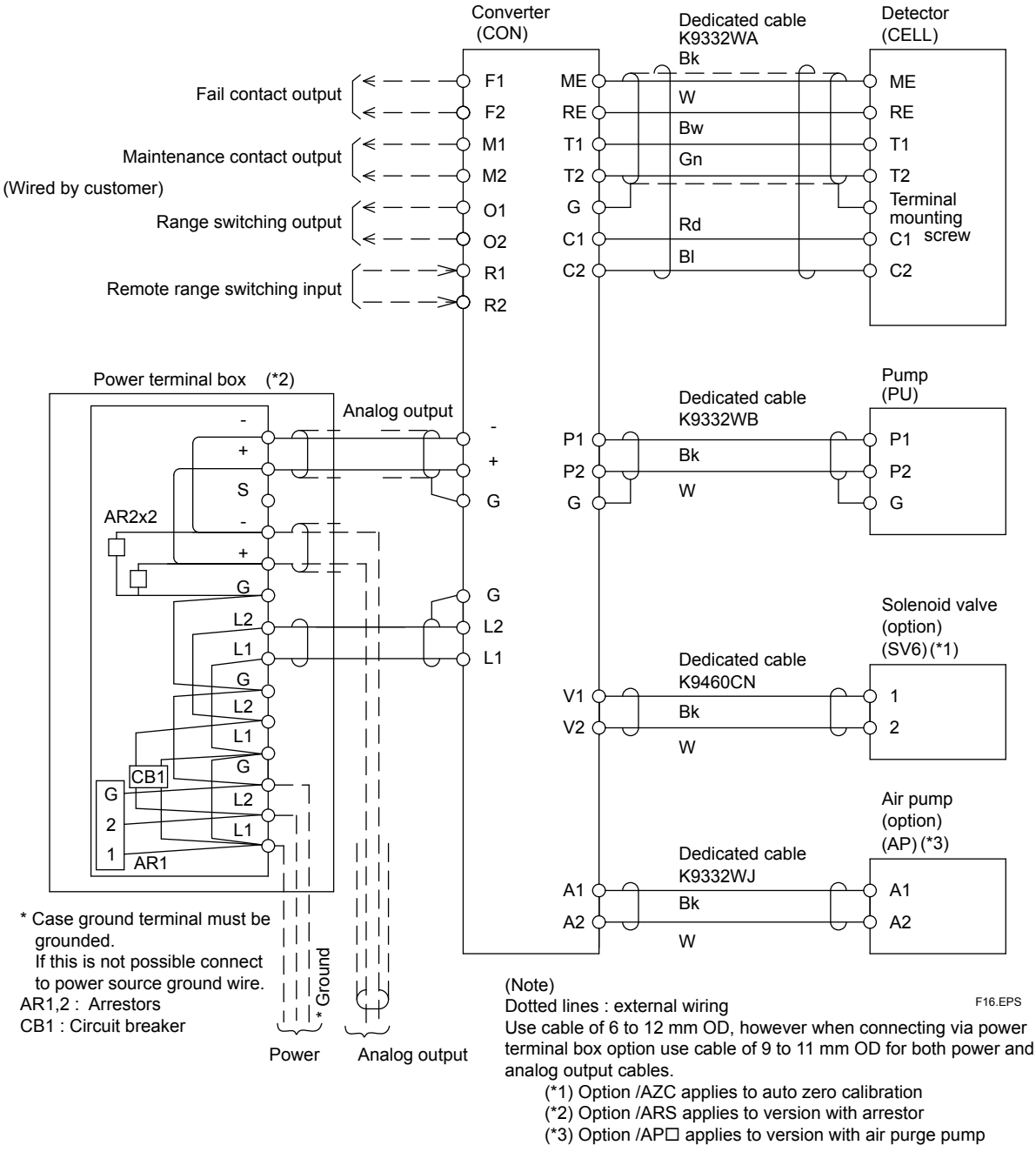
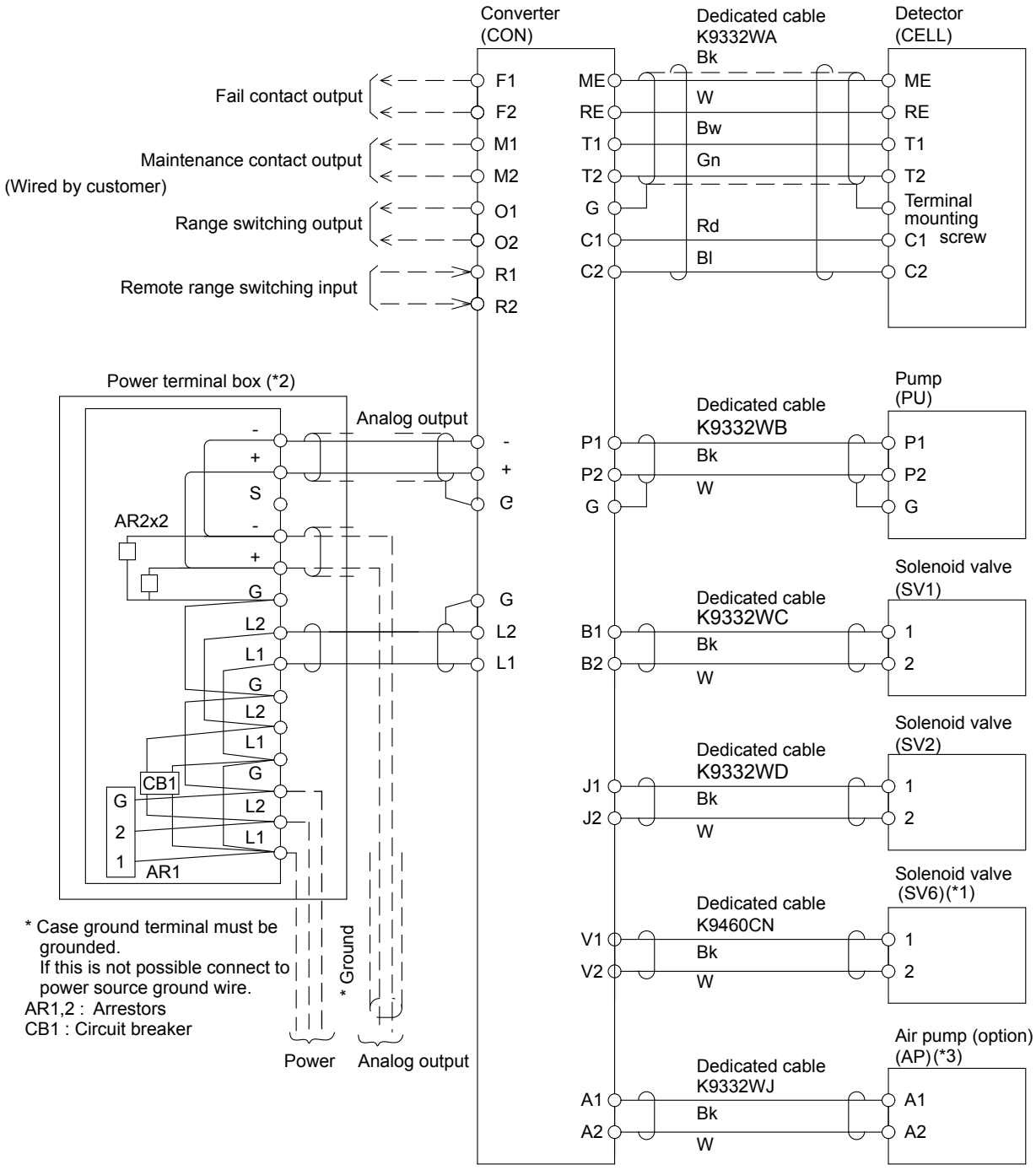


Figure 3.5 RC400G-1/ARC/AZC

RC400G-2 Residual Chlorine Analyzer for Raw Water

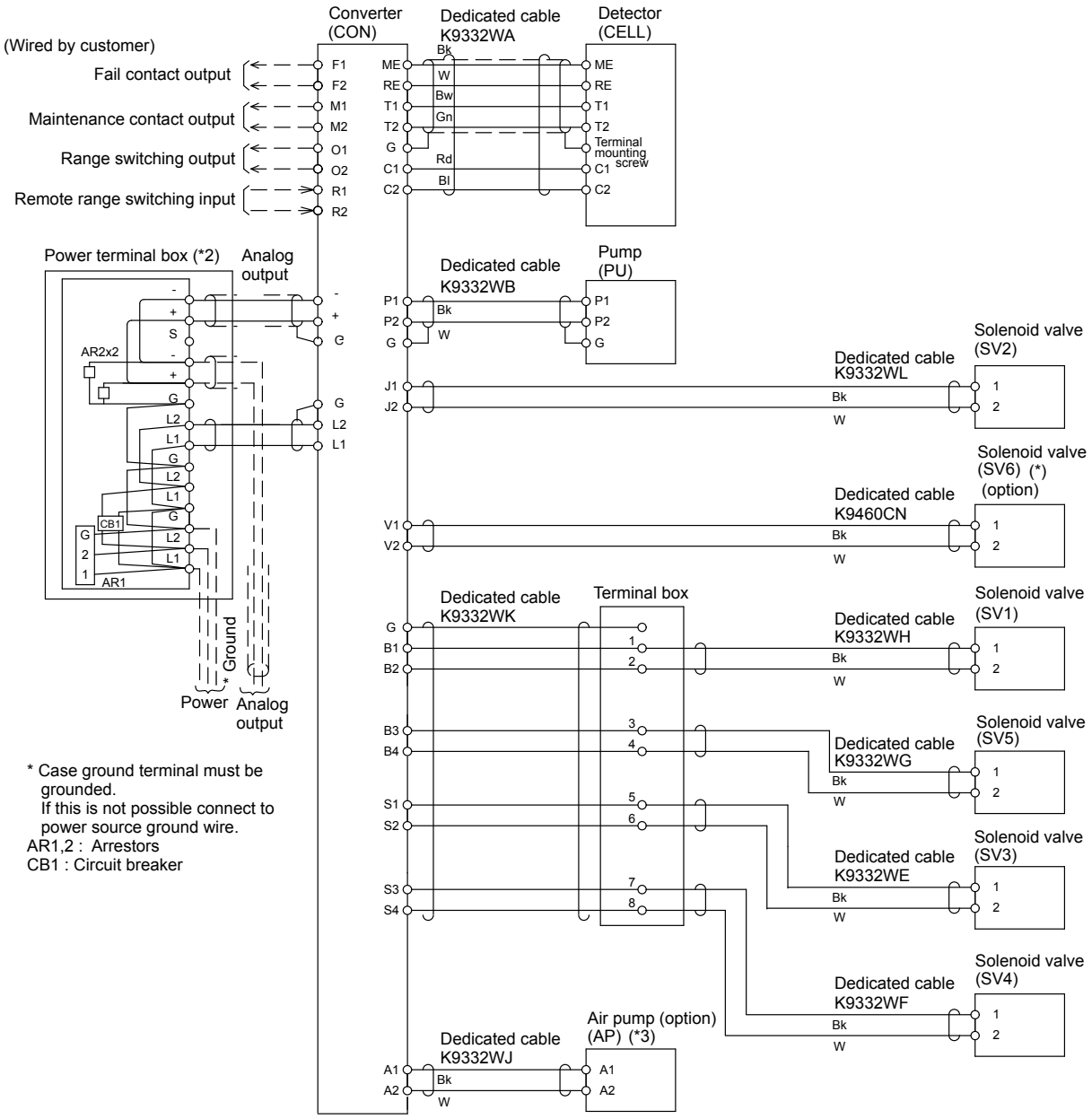


(Note)
Dotted lines : external wiring
Use cable of 6 to 12 mm OD, however when connecting via power terminal box option use cable of 9 to 11 mm OD for both power and analog output cables.
(*1) Option /AZC applies to auto zero calibration
(*2) Option /ARS applies to version with arrestor
(*3) Option /AP☐ applies to version with air purge pump

F17.EPS

Figure 3.6 RC400G-2/ARS/AZC

RC400G-3 Residual Chlorine Analyzer for Raw Water



* Case ground terminal must be grounded.
If this is not possible connect to power source ground wire.
AR1,2 : Arrestors
CB1 : Circuit breaker

(Note)
Dotted lines : external wiring
Use cable of 6 to 12 mm OD, however when connecting via power terminal box option use cable of 9 to 11 mm OD for both power and analog output cables.
(*1) Option /AZC applies to auto zero calibration
(*2) Option /ARS applies to version with arrestor
(*3) Option /AP☐ applies to version with air purge pump

F18.EPS

Figure 3.7 RC400G-3/ARS/AZC

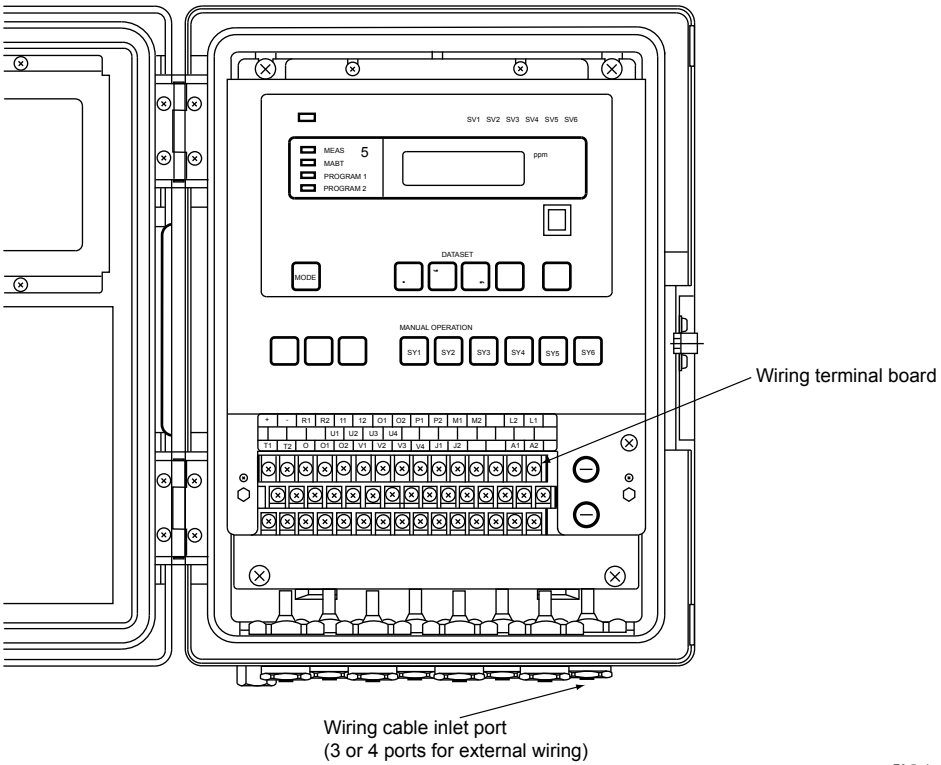


Figure 3.8 External Wiring Terminal Board and Cable Inlet Port in Converter

Whereas the converter has 8 cable inlet ports, 5 out of the 8 ports have been assigned to internal wiring and only 3 ports are available for external wiring.

NOTE

In the RC400G-1 analyzer which has no air pump, 4 ports are available for external wiring.

Use one cable for each wiring. The analog output wiring and contact input wiring are collected together in one cable as a rule, but they can be assigned separate cables if cable ports are available.

NOTE

Stop cable ports not in use with plugged cable glands.

3.3.1 Wiring for Power Supply and Grounding

This is for supplying power of voltage and frequency meeting the specification of the analyzer and for grounding the converter case.

Connect the terminals L1 and L2 of the converter to power supply with a two-conductor cable of 6 to 12 mm finished O.D..

When the analyzer is equipped with arrestors (when option code “/ARS” is specified), connect terminals L1 and L2 to the power terminal box (a circuit breaker is incorporated).

Refer to Figures 3.5 to 3.7.

NOTE

The converter does not have a power switch. A double-pole switch should be installed in the power line. A power switch for the converter is necessary to prevent electric shock or damage to the instrument when inspection or maintenance of electric system is performed with power supplied.

Treat the end of cable to be connected to the converter terminal in the following manner:

(1) Strip of the insulation covering from the cable at its end approx. 80 mm.

(2) Attach to the tip of the conductor a crimping type terminal lug which fits an M4 screw.

For grounding, use the grounding terminal marked “⏚” at the bottom of the converter case.

Provide grounding by connecting the end-treated (for sufficient conduction) grounding lead to the M5 screw of the grounding terminal (grounding resistance must be 100 Ω or less).

NOTE

When the grounding terminal of the converter case cannot be used, connect the grounding lead to terminal G (M4 screw) inside the converter and ground the lead at the power supply. For this, use a two- or three-conductor shielded cable for power supply and grounding wiring.

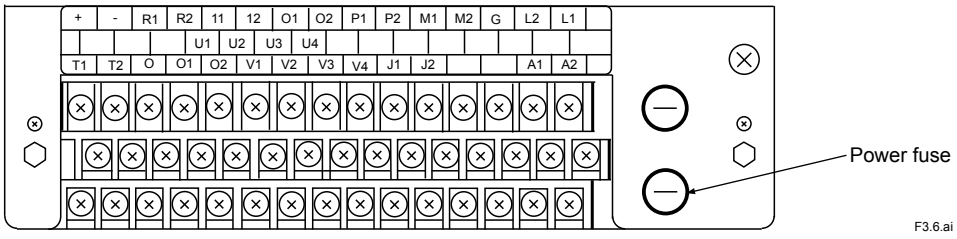


Figure 3.9 Wiring Terminals of Converter

3.3.2 Wiring for Analog Output Signals

This is for transmitting output signals of 1 to 5 V DC or 4 to 20 mA DC by the respective range to receives such as a recorder. Use a two-conductor shielded cable of 6 to 12 mm finished O.D..

When the analyzer is equipped with arrestors (when option code “/ARS” is specified), connect terminals L1 and L2 to the power terminal box (a circuit breaker is incorporated).

Refer to Figures 3.5 to 3.7.

NOTE

For <remote> range switching, use a four-conductor (including this wiring) shielded cable.

Treat the cable at its end to be connected to the converter terminal in the following manner.

(1) Strip of the insulation covering of the cable at its end, approx. 60 mm, and solder a lead wire to the base of the exposed shield.

Protect the soldered part by wrapping with insulation tape or other means.

(2) Cut the lead wire and each conductor to equal length and attach to the lead wire and conductors tips crimping type terminal lugs which fit M4 screws.

(3) Connect the cable to + and - terminals of the converter. Connect the positive pole conductor to the terminal OUTPUT at “+”, and the negative pole conductor to “-”, respectively.

Connect the lead wire of the shield to terminal G. (Do not double ground the shield connected to terminal G at the receiver end.)

3.3.3 Wiring for Contact Input (<remote> Range Switching)

The two output ranges are switchable to each other arbitrarily. Range switching can be performed either <remote> or <local>.

The wiring herewith described is provided for switching the range with <remote> (see subsection 5.3.4 (10)).

Use the remainder of the cable used for the analog output signal wiring described in subsection 3.3.2.

Connect the two conductors of the cable to terminals R1 and R2.

NOTE

When cable inlet ports are available, the wiring described above can be made with two separate cables. For that, employ a two-conductor cable of 6 to 12 mm finished O.D.. Treat the cable end in the same manner as the analog output signal cable.

Contact inputs ON (“Output range-2” is selected) and OFF (“Output range-1” is selected) are identified by the resistance condition shown in Table 3.1. On wiring, ensure that a contact meeting this condition is used.

Table 3.1 Identification of ON and OFF of Contact Input for <remote> Range Selection

	Identification ON (Output range-2)	Identification OFF (Output range-1)
Resistance (contact)	200 Ω or less	100 kΩ or more

3.3.4 Wiring for Contact Output

The converter supplies contact signals of either <failure>, <maintenance> or <range>, for which contact output wiring is provided.

For the wiring, use a cable or 6 to 12 mm finished O.D. (select a two-, three- or four-conductor cable depending on the number of contract outputs used.)

Treat the cable end to be connected to the converter terminals in the same manner as the analog output signal cable (see subsection 3.3.2.)

Connect each conductor of the cable to terminals F1, F2 (contact output <failure>), M1, M2 (contact output <maintenance>) and O1, O2 (<range> switching contact), respectively.

Contact capacity of the contact output relay is given in Table 3.2. Equipment to be connected must meet the condition shown by the table.

Table 3.2 Contact Capacity of Contact Output Relay

	with DC	with AC
Contact maximum allowable voltage	220 V	250 V
Contact maximum allowable current	2 A	2 A
Contact maximum allowable power	60 W	125 VA

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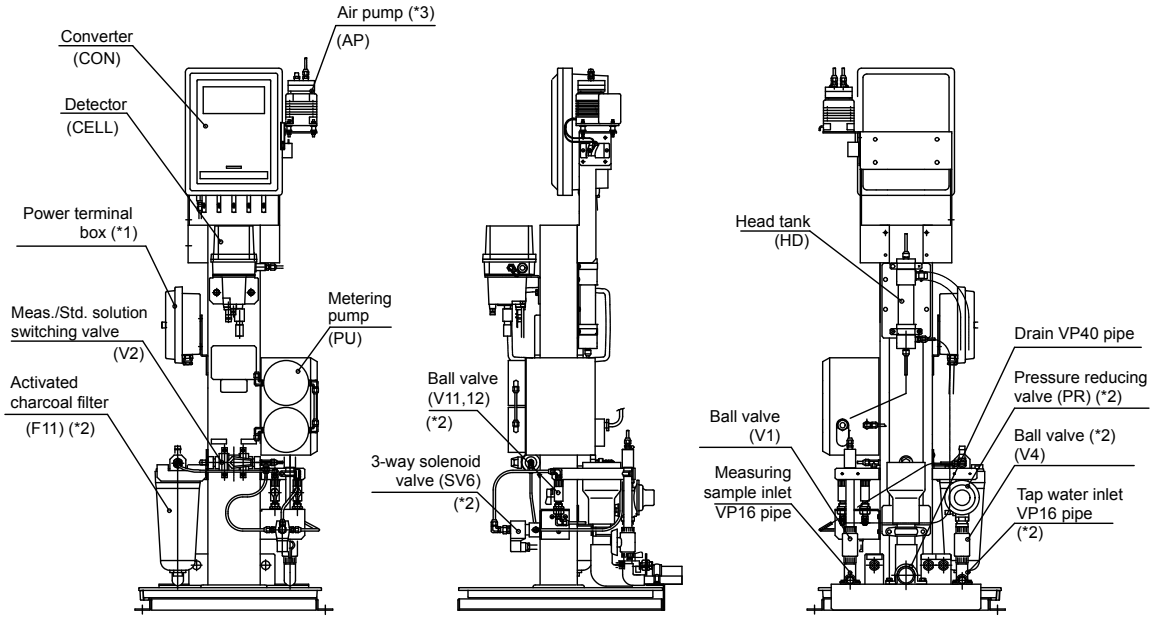
4. Operation

This chapter chiefly describes preparation procedures for stable analyzer operation.

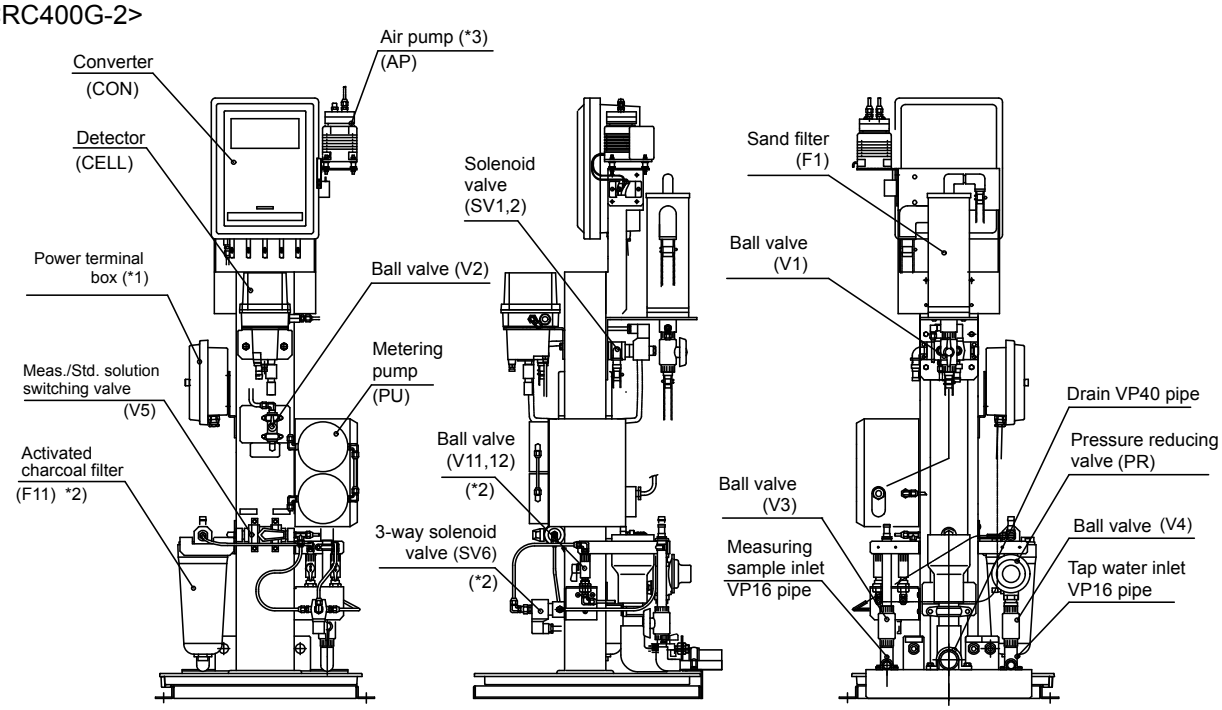
4.1 Component Identification and Function

<RC400G-1>



(*1) Option / ARS applies to model with arrestors
(*2) Option / AZC applies to model with auto zero calibration
(*3) Option / AP☐ applies to model with air pump

<RC400G-2>



(*1) Option / ARS applies to model with arrestors
(*2) Option /AZC applies to model with auto zero calibration
(*3) Option / AP☐ applies to model with air pump

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<RC400G-3>

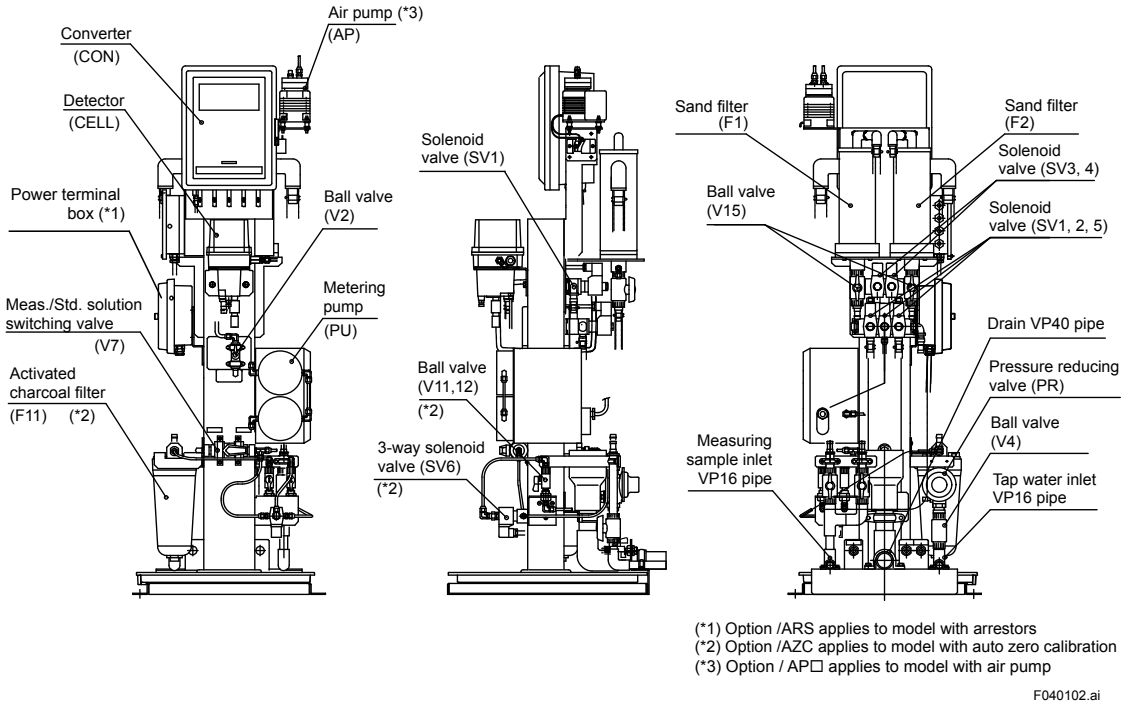


Figure 4.1 Component Identification and Functions and Residual Chlorine Analyzer (1)

Converter

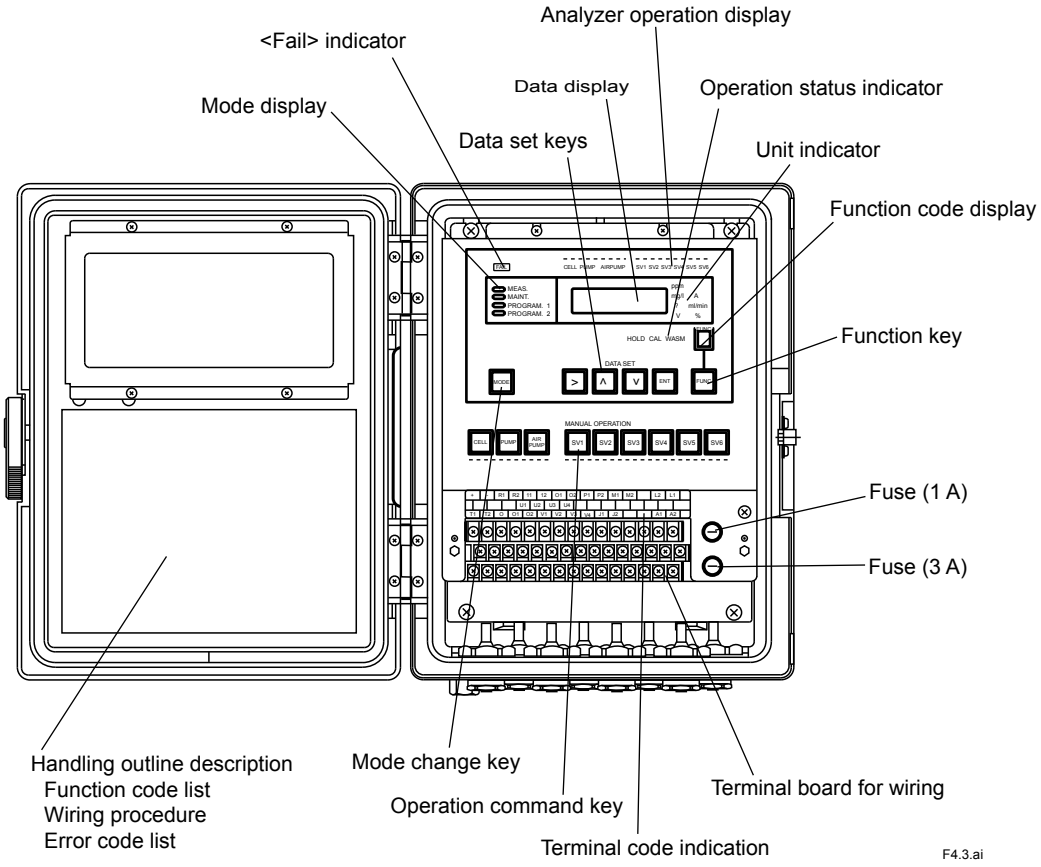
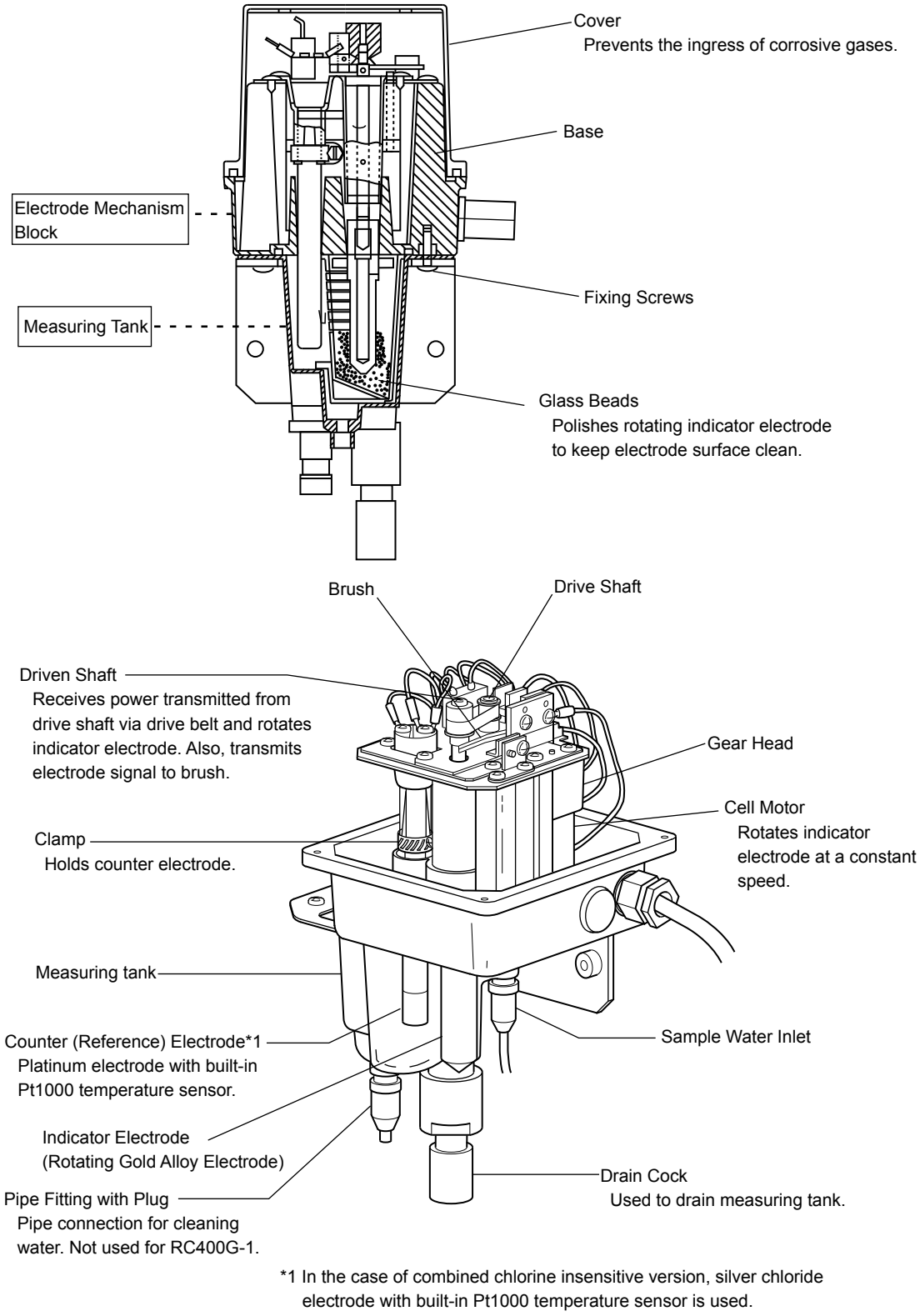


Figure 4.2 Component Identification and Functions of Residual Chlorine Analyzer (2)

Detector and electrode mechanism block



*1 In the case of combined chlorine insensitive version, silver chloride electrode with built-in Pt1000 temperature sensor is used.

F4.2.ai

Figure 4.3 Component Identification and Functions of Residual Chlorine Analyzer (3)

4.2 Preparation for Operation

4.2.1 Reagent Preparation

Reagent used for measurement differs in free available chlorine measurement and residual chlorine (total chlorine) measurement. Also, in total chlorine measurement, the component amounts in the reagent must be changed depending on the chlorine concentration in the solution to be measured.
Prepare reagents using the following procedure for each case. Keep prepared reagents in reagent tanks.

● Preparation of Reagent for Free Available Chlorine Measurement (max. concentration: 10 mg/l)

As reagent components, use potassium bromide (KBr) which reacts with the free available chlorine present in a measuring sample to liberate bromine, acetic acid (CH_3COOH) for maintaining measuring sample pH at 4.5 to 5.0, and sodium acetate (CH_3COONa).
If a reagent solution of 100 liter is to be prepared, obtain a mixed reagent solution of a total of a 100 liter by dissolving 4000 g of JIS grade 1 KBr, 1000 g of sodium acetate and 1000 ml of acetic acid (95 % or higher) into approx. 80 liter of purified water, and then adding additional purified water to make 100 liter.

Table 4.1 Reagent Composition and Its Component Quantities

Measurement Object / Reagent Composition	Free Chlorine
	Quantity in 100 l
KBr	4000 g
CH_3COONa	1000 g
CH_3COOH	1000 ml

● Preparation for Combined Chlorine

Table 4.2 Reagent Composition and Its Component Quantities

Measurement Object / Reagent Composition	Free Chlorine
	Quantity in 100 l
KBr	4000 g
CH_3COONa	5400 g
CH_3COOH	200 ml

● Preparation of Reagent for Measuring Residual Chlorine

As reagent components, use potassium iodide (KI) which reacts with free chlorine present in a measuring sample to liberate iodine, acetic acid (CH_3COOH) for maintaining measuring sample pH at 4.5 or less, and sodium acetate (CH_3COONa).
The amount of potassium iodide to be used varies with the residual chlorine concentration. See Table 4.3.

Table 4.3 Reagent Composition and Its Component Quantities

Measurement Object and Max. Concentration	Residual Chlorine	
	Up to 6 mg/l	More than 6 mg/l to 10 mg/l (inclusive)
	Quantity in 100 l	
KI	500 g	1000 g
CH_3COONa	150 g	150 g
CH_3COOH	1000 ml	1000 ml

4.2.2 Filling Bead Case with Electrode Polishing Glass Beads

Contamination adhering to the gold alloy surface of the gold alloy rotating electrode results in measured value error. To prevent such error owing to contamination, the gold alloy surface is continuously polished with glass beads during operation.

Fill the bead case in the measuring tank with glass beads which are delivered by placing in the accessory box.

■ Glass Beads Filling Procedure

(1) Remove the electrode mechanism block by loosening two fixing screws.

(2) Put the glass beads into the bead case.

Feed the glass beads up to the lowest slit position (approx. 4 cm above the bottom) of the bead case.

(3) Restore the electrode mechanism block.

Note: The upper surface of the glass beads with the indicator electrode placed in the bead case is to be located 1 cm higher than the lowest slit position.

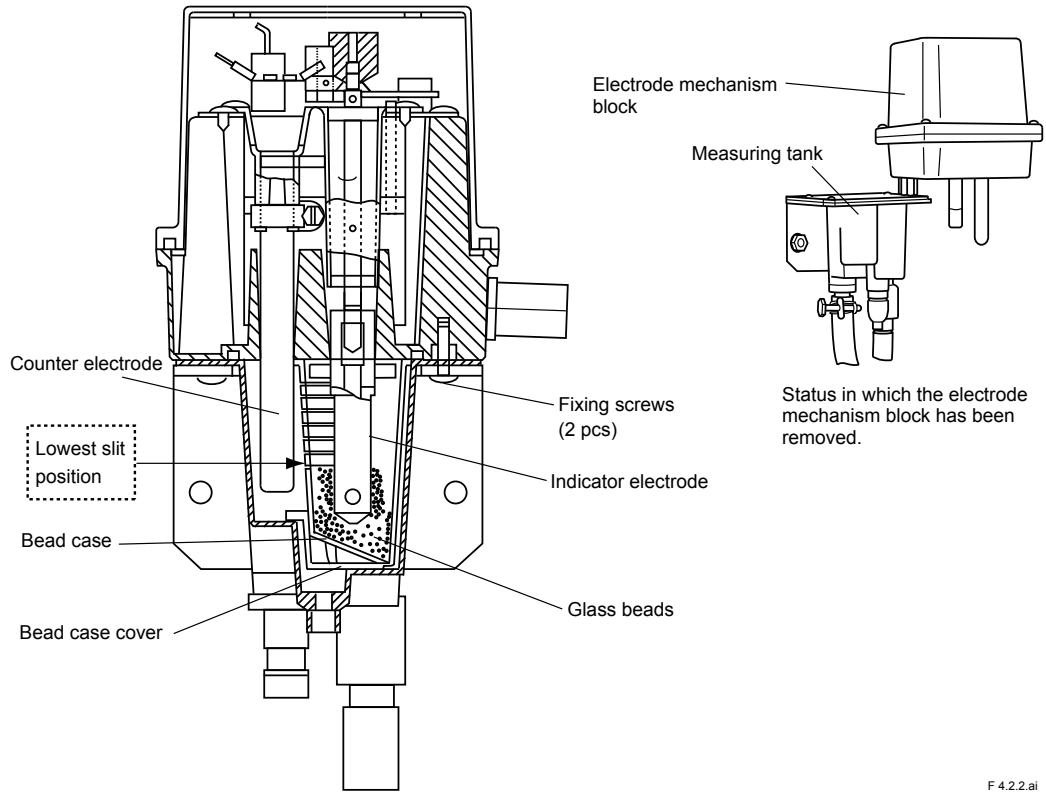


Figure 4.4 Detector Construction

4.2.3 Checking the Sand in the Sand Filter

This is a check to be performed when a residual chlorine analyzer for raw water or treated water is used.

Confirm that the sand filter is filled with sand up to the scale “10” position of the filter cylinder. If lacking, replenish the sand by opening the upper cover of the cylinder. Use filter sand having an effective dia. of 0.6 mm and uniformity coefficient of 1.4 as adopted in filtration plants.

4.3 Startup

Proceed with the work sequentially in accordance with subsections 4.3.1 to 4.3.12.

Prior to starting work, reviews chapter 5 and 6 to understand the outlines of the key operations and analyzer operation.

4.3.1 Confirming Tubing and Wiring Implementation

Confirm the proper connections of tubing and wiring to the residual chlorine analyzer referring to sections 3.2 and 3.3.

4.3.2 Feeding Sample Water and Adjusting Flow

(1) Feed sample water with the ball valve (*1) in the sample water line at the rear of the analyzer fully closed.

*1: RC400G-1 For tap water: V1 (see subsection 3.2)
RC400G-2 For raw water: V3 (see subsection 3.2)
RC400G-3 For treated water: V3, V4 (see subsection 3.2)

(2) Gradually open the ball valve described in (1) to feed the sample water at the predetermined rate (*2).

*2: RC400G-1 For tap water: 1 to 4 l/min
RC400G-2 For raw water: 5 to 10 l/min
RC400G-3 For treated water: 10 to 20 l/min (5 to 10 l/min for one stream)

Adjust valve opening so that the sample water flows out of the drain port on the side of the head tank or sand filter keeping the drain water at the level of one quarter of the drain port diameter.

4.3.3 Supplying Cleaning Water

This step is necessary only for an analyzer for raw water (the RC400G-2) or treated water (the RC400G-3) measurement. Supply cleaning water at a pressure of 100 to 500 kPa to the analyzer.

In so doing, leave the ball valve in the cleaning water line, (V4 for raw water), (V6 for treated water), at the rear of the analyzer, open. Also, keep the ball valves in the filter sand cleaning line located under the sand filter and in the glass bead cleaning line [V1, V2 (for raw water)], [V1, V2, V5 (for treated water)] fully closed after confirming that no cleaning water leaks from the solenoid valve in the "closed" state.

4.3.4 Turning on Power

First confirm that the power supply voltage and frequency meet the analyzer specifications. In addition, verify to ensure that the converter fuse holder cap is not loose.

The analyzer itself has no power switch. It operates by the turning On of a switch provided in the power line.

When the power is supplied, analyzer start in <MEAS.> mode and metering pump and cell motor which rotate indicator electrode are always turned on.

After starting analyzer operation, press [MODE] key in the converter to enter in <MAINT.> mode.

Note: When option code “/ARS” (with flame arrester) is specified, there is a power switch (circuit breaker) in the power terminal box.

4.3.5 Confirming Sample Water Metering Pump Delivery Flow

The sample water metering pump has been adjusted to deliver the required flow. Verify to ensure the flow using the following procedure:

Prepare a 200 ml graduated cylinder to be used for verifying.

(1) Confirm that the analyzer is in <MAINT.> mode and then display “7” in the function code display using the [FUNC] key. The content of this code is “measurement of sample water metering pump flow”. The data display indicates “FLo_1”.

(2) Drain the sample water out of the drain cock at the bottom of the measuring tank and measure the delivery flow rate by cylinder to a definite volume (150 ml).

- Loosen the drain cock. Drain out the water stored in the measuring tank and then introduce the sample water flowing out of the drain cock into the graduated cylinder.
- Press [ENT] key the instant the sample water reaches the reference graduation of the graduated cylinder. At this moment, the data display indication changes to "sec" count.
- Press [ENT] key again the instant the sample water in the cylinder increases by 150 ml from the reference graduation.

  After the above operation is performed, the converter computes taking the number of seconds counted as the time per pump delivery of 150 ml and indicates flow rate in the data display. If the flow rate is 50 ±5 ml/min, the sample water metering pump delivery flow is normal.

  If incorrect, make adjustment by changing the stopper position in the pump driving assembly (see section 8.8).

(3) Close the drain cock. next confirm the reagent metering pump delivery flow.

4.3.6 Confirming Reagent Metering Pump Delivery Flow

The reagent metering pump has been adjusted to deliver the required flow. Verify to ensure the flow in a similar manner to that of sample water:

Prepare a 50 ml burette and an approx. 120 cm-long soft PVC tube of O.D. 6 mm and I.D. 4 mm. To facilitate the work, also prepare a burette stand.

(1) Confirm that the analyzer is in <MAINT.> mode and then display “8” in the function code display using the [FUNC] key. The content of this code is “measurement of reagent metering pump flow”. The data display indicates “FLo_2”.

(2) Press [PUMP] key to once stop the metering pump operation.

(3) Close the ball valve (*1) in the reagent flow line. Remove the tubing connected to the reagent metering pump suction tubing joint.

*1: RC400G-1 For tap water: V3
RC400G-2 For raw water: V6
RC400G-3 For treated water: V8

(4) Connect the prepared soft PVC tube to the burette and fill the tube and burette with water (alternative of reagent). Connect the opposite end of the PVC tube to the reagent metering pump suction tube joint and then set the burette as shown in Figure 4.5.

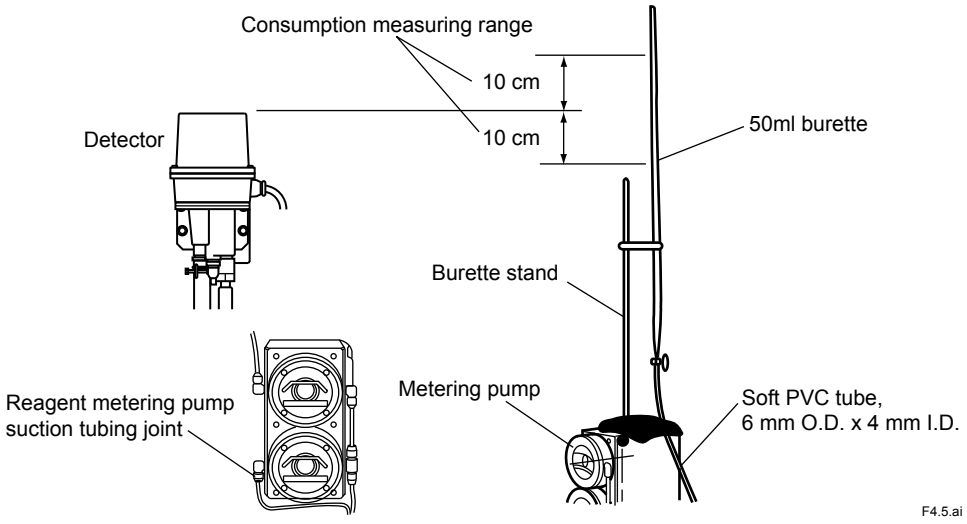


Figure 4.5 Burette Setting

(5) Measure the delivery flow rate using the method for measuring a time interval in which water in the burette is consumed by a definite volume (4.5 ml). Consumption should be measured in the range of ±10 cm at the upper end position (reference) of the detector.

- Press [PUMP] key and again operate the metering pump.
- Press [ENT] key the instant when the water level inside the burette lowers to the reference graduation (arbitrarily specified) within the limited burette range. At this moment, the data display indication changes to “sec” count.
- Since water level in the burette further declines, again press [ENT] key when the water level lowers by 4.5 ml from the reference graduation.

  After the above operation is performed, the converter computes taking the number of seconds counted as the time per pump delivery of 4.5 ml and indicates flow rate in the data display. If the flow rate is 1.5 ±0.15 ml/min, the reagent metering pump delivery flow is normal.

  If incorrect, make adjustment by changing the stopper position in the pump driving assembly (see section 8.8).

(6) Press [PUMP] key and once stop the metering pump. Remove the tube connected to the reagent metering pump suction tubing joint and restore the tubing.

(7) Open the ball valve in the reagent flow line. Also, press [PUMP] key to operate the metering pump.

4.3.7 Confirming Indicator Electrode Operation

Remove the electrode mechanism block cover and confirm that the cell motor is rotating. Also confirm that there is no fluttering or eccentric deflection in the indicator electrode revolution.

If the cell motor is in operating status, <CELL> lamp is lit.

4.3.8 Confirming Cleaning Solenoid Valve Operation and Adjusting Ball Valve Opening

There are performed only for the residual chlorine analyzer RC400G-2 or RC400G-3 for raw water or treated water.

Perform solenoid valve operation confirmation and ball valve opening adjustment in the following procedure:

(1) Adjust the flow rate of cleaning water entering the sand filter.

- First press [SV1] key and actuate solenoid valve SV1 (valve: open). Confirm that solenoid valve SV1 has operated, though lighting of <SV1> lamp.
- Next, adjust the opening of ball valve V1 located under the sand filter. Open the valve to the extent that the sand in the sand filter is not forced up above the sample water inlet.
- After adjusting the ball valve opening, again press [SV1] key to stop operation of solenoid valve SV1.

  If a residual chlorine analyzer for treated water is used, adjust also the flow of cleaning water entering another sand filter.
- Press [SV5] key to operate solenoid valve SV5 (valve: open). Adjust ball valve V5 to the extent that the sand in the sand filter is not forced up above the sample water inlet.

(2) Adjust the flow rate of cleaning water entering the measuring tank.

- First press [SV2] key to operate solenoid valve SV2 (valve: open). When solenoid valve SV2 operates, <SV2> lamp is lit.
- Next, gradually open ball valve V2 to adjust the flow. Adjust it to the extent that glass beads float in the measuring tank and that the water level does not exceed the second slit of the bead case from its top.

- After adjusting cleaning water flow rate, press again [SV1], [SV2], and [SV5] keys to stop operation of solenoid valves SV1, SV2, and SV5.

Operating times related to cleaning are already set on shipment. Since these sequential operations become stopping states in <MAINT.> mode, set the mode in <MEAS.> mode for sequence operation. However, even in <MAINT.> mode, cleaning operation can be manual-started though operations at the function codes “4”, “5”, and “6” (see 5.3.3 (3)).

If setting times related to cleaning are to be changed, perform setting referring to subsection 5.3.5.

4.3.9 Purging Air Supplying

Halogen gases are strongly corrosive. To protect metallic parts from corrosion owing to intrusion of halogen gases generated from sample water, purge the inside of enclosures such as the electrode mechanism block with air.

If an air pump is attaches, press [AIRPUMP] key to operate this pump. If “on” has been selected with the function code “d.” in <PROGRAM. 1> mode, setting <MEAS.> mode starts pump operation without pressing the key for selecting the operation status.

NOTE

If optionally specified for air pump addition, the analyzer is shipped from the factory with the setting “on”.

If instrument air is to be used, supply it by regulating the pressure to 140 kPa.

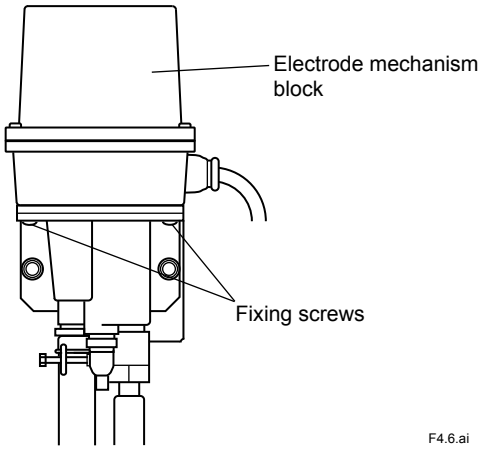
Tightly close the cover of the enclosure to be air-purged.

4.3.10 Polishing Indicator Electrode

The gold alloy surface of the indicator electrode must be kept clean. Polish the gold alloy surface in the following procedure:

(1) Confirm that the mode is <MAINT.> and then press [CELL] key on the control panel to stop revolution of the indicator electrode. When the electrode stops rotating, <CELL> lamp extinguishes.

(2) Remove the electrode mechanism block from the measuring tank and set it as shown in Figure 4.7. The electrode mechanism block is fixed with two screws to the measuring tank bracket.



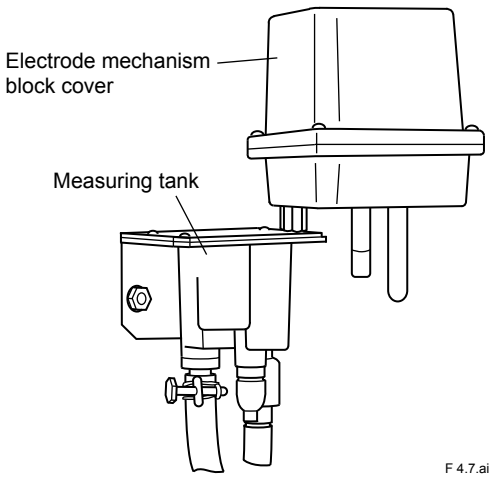


Figure 4.6 Electrode mechanism block fixing screws **Figure 4.7 Measuring tank status in maintenance**

(3) Remove the indicator electrode.

Remove the electrode mechanism block cover of the detector. Detach the rotating electrode with the end of the driven shaft supported by hand so that the driven shaft does not rotate. Since the electrode is screws into the driven shaft, turn the electrode counterclockwise.

Exercise care not to touch the brush.

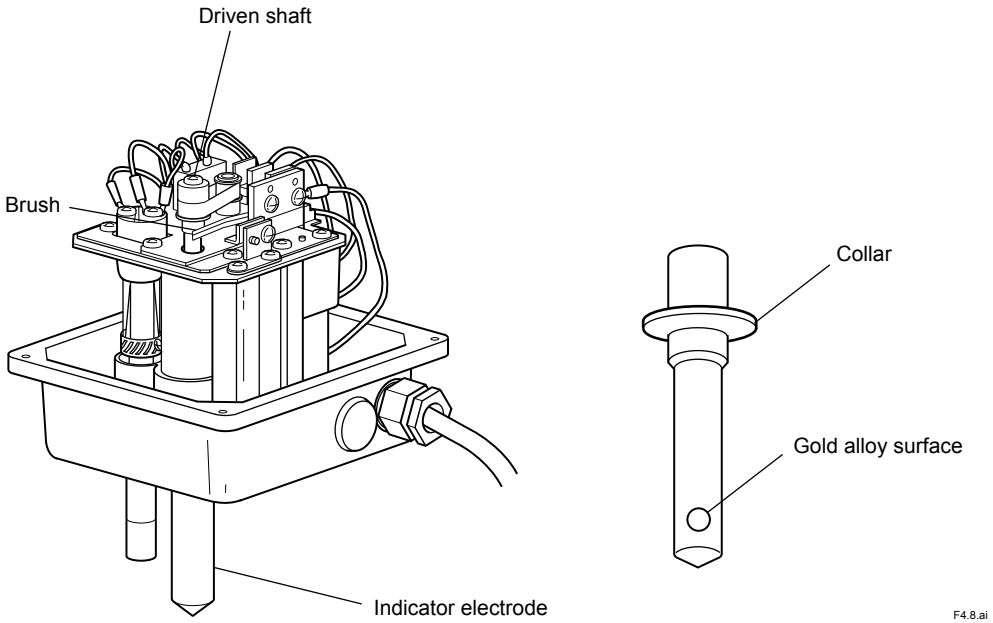


Figure 4.8 Appearance of electrode mechanism block and Indicator electrode

(4) Polish the gold alloy surface of the indicator electrode.

Place the polishing agent (alumina) supplied as one of the accessories on a piece of moist gauze and carefully polish the electrode until any contamination owing to oil and grease is completely removed using clean water.

After polishing, confirm that the contamination is completely removed. The cleaned surface of the gold alloy must be uniformly wet with water. When dried, the gold alloy surface also dries uniformly. No undried water drops will remain.

(5) Mount the indicator electrode.

Fully screw in the electrode while supporting the driven shaft by hand so that it does not rotate. Do not touch the gold alloy surface.

(6) Mount the electrode mechanism block cover. Return the electrode mechanism block into the measuring tank and fix it to the bracket using two screws.

(7) Press [CELL] key to rotate the electrode.

4.3.11 Filling the Zero Filter Case and Running-in Operation

To allow smooth automatic zero calibration, the zero filter case should be filled with zero water in advance. Immediately after a filter is installed or when time has passes since the last calibration was performed, operate the analyzer without turning on zero calibration and conduct running-in operation.

(1) Make sure that solenoid valve SV2 is closed. Then, open the solenoid valve SV6. (The RC400G for tap water does not have the solenoid valve SV2.)

(2) Check that no leakage has occurred and no air bubbles have formed.

(3) Allow the analyzer to operate continuously for about 20 minutes. Make sure that the residual chlorine analyzer reads approximately zero. After the running-in is completed, set the cycle, preparation time and relaxation time of automatic zero calibration to the values in accordance with the sample water and measurement conditions. (Refer to subsections 5.2.3 and 5.2.4.)

4.3.12 Output Range Setting

There are two output ranges “output range-1” and “output range-2” and either of them can be output.

The above two ranges can be selected <local> or <remote>.

In <remote> selection, “output range-1” is output when the contact of the range selection contact input is “open”, while “output range-2” is output when the above contact is “closed”. On shipment, the range selection is set to <local>.

If the range is to be selected <remote> or “output range-2” is to be output, reset the range selection referring to 5.3.4 (7).

The range for “output range-1” set on shipment is 0.00 to 5.00 mg/l and the range for “output range-2” set is 0.00 to 10.00 mg/l.

If range change is required, refer to 5.3.4 (1).

4.3.13 Calibration

Calibrate zero and span. For practical calibration procedure, see 5.3.3 (1) and (2) and chapter 7.

Now the startup takes are completed.

If the data set on shipment from the factory are changed, note them.

The setting data is stored in EEPROM. Hence, the data is not lost even if power is turned OFF.

However, if memory failure is detected and memory contents are initialized, the data may be lost in this case.

4.4 Operation

If operation conditions are arranged at startup, there is no need to perform adjustment or control in actual operation.

However, inspection and maintenance for maintaining good operating condition are necessary, such as replenishing consumed reagent at a predetermined period. Determine maintenance items and periods referring to Chapter 8 “Maintenance”.

The RC400G residual chlorine analyzers have the function for displaying various data items effective for understanding operating conditions, not limited to residual chlorine concentration (see subsection 5.3.2).

It is recommended that this function be fully utilized.

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5. Converter Operation

The converter has functions for cleaning sequence, failure detection, and self-diagnosis by fully utilizing the incorporated microprocessor as well as the residual chlorine concentration measuring function.

The converter is operated when executing various data value display, solenoid valve operation commanding, and operation parameters entry, etc..

This chapter describes key operations and display contents indicated in this displays.

5.1 Component Identification and Functions on the Control Panel

Converter operations are all performed on the control panel. The control panel includes displays for data, mode, function code, and others, in which measured values and operating conditions are displayed.

Figure 5.1 shows the control panel.

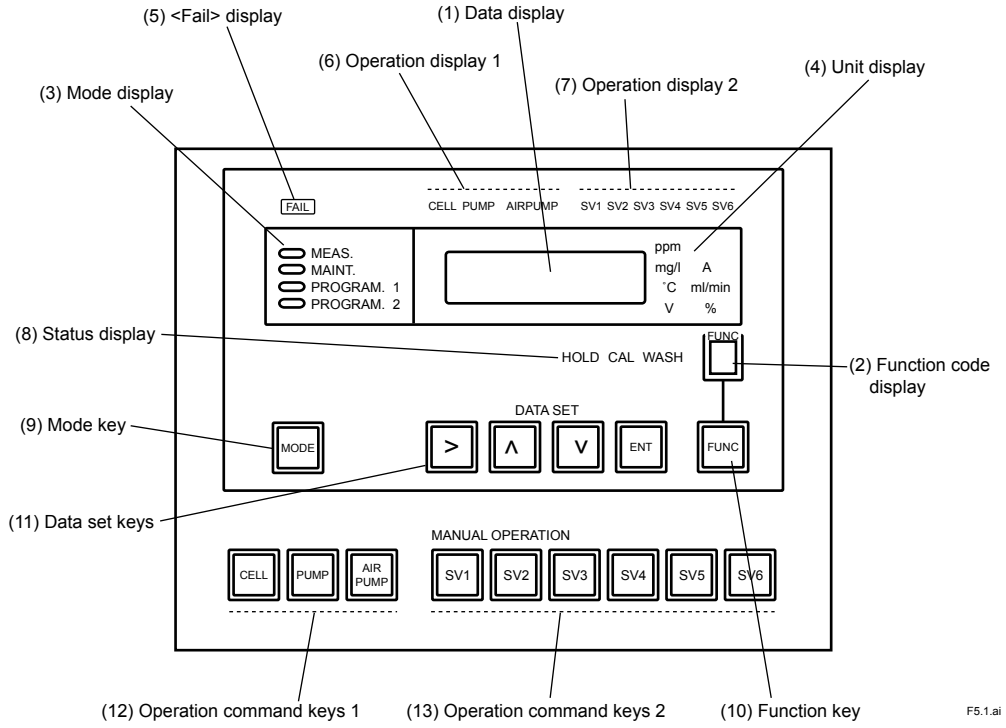


Figure 5.1 Control Panel

Table 5.1 Operation Key/Display Names and Functions

	Name	Function
(1)	Data display (indicated by red LEDs)	Measured values, setting data, message, etc. are displayed.
(2)	Function code display (indicated in red)	A selected function code is displayed.
(3)	Mode display (indicated in green; lamp lights)	A operation mode is displayed. A lamp relevant to the current mode is lit.
(4)	Unit display (indicated in green; diffused lighting)	One of data units is displayed. A unit for the data displayed in the data display is lit.
(5)	<Fail> display (indicated in red; diffused lighting)	This is lit when the processor fails or a failure is detected.
(6)	Operation display 1 (indicated in green; diffused lighting)	This goes ON/OFF corresponding to turning ON/OFF of the cell motor, pumps and air pump.
(7)	Operation display 2 (indicated in green; diffused lighting)	This goes ON/OFF corresponding to turning ON/OFF of solenoid valves.
(8)	Status display (indicated in green; dif-fused lighting	Each status item of "output HOLD", "CALibration", and "WASHing" lights, flashes, and flashes respectively when actuated, otherwise those extinguish.
(9)	Mode key	This is used for selecting operation mode.
(10)	Function key	This is used for selecting the function code.
(11)	Data set keys	These are used when set data is to be changed or calibrating operation is performed.
(12)	Operation command keys-1	These are used when the cell motor, pump, or air pump are to be turned ON/OFF. Every time a key is pressed, the pump cell motor, or air pump relevant to that key is turned ON/OFF.
(13)	Operation command keys-2	These are used when solenoid valves are to be turned ON/OFF. Every time a key is pressed, the solenoid valve relevant to that key is turned ON/OFF.

5.2 Operation Modes and Functions

Operation of the residual chlorine analyzer is determined broadly by three operation modes (modes are classified into four types).

(1) Measuring mode (<MEAS.> mode)

(2) Maintenance mode (<MAINT.> mode)

(3) Setting mode

- Data setting/operation setting mode (<PROGRAM.1> mode)
- Cleaning sequence setting/Failure detecting function selection mode (<PROGRAM.2> mode)

Data display items and setting items, and command items such as calibration are determined using Function in each mode. The setting data is stored in EEPROM.

Thus, various operations are performed by specifying a mode and a function code.

Table 5.2 briefly shows each mode and function codes in that mode. For specific contents of each function code, see subsections 5.2.1 to 5.2.4.

Table 5.2 Outline of Modes and Function Codes

Mode	Function Code	Description
MEAS.	1 to 9	• A mode for actual operation. Residual chlorine concentration is measured. • By specifying a function code using [FUNC] key, residual chlorine concentration, liquid temperature, applied voltage, diffusion current, etc. can be displayed. • If "execution" of cleaning function is selected, sequence operation is performed (for RC400G-2 or RC400G-3).
MAINT.	1 to F	• This is the mode in which maintenance is performed and calibration or taking plateau characteristics can be done (execution items are selected using [FUNC] key. • Operations using data set keys or operation command keys are available.
PROGRAM.1	1 to F	• Data setting can be performed, such as output range setting or applied voltage setting (setting items are selected using ([FUNC] key). • Operations using data set keys or operation command keys are available.
	1. to F.	• Operating functions can be selected, such as range selection (remote/local) or cleaning function "execution/stop" (setting items are selected using [FUNC] key). • Operations using data set keys or operation command keys are available.
PROGRAM.2	1 to F	• Time settings for cleaning sequence can be performed (setting items are selected using [FUNC] key). • Operations using data set keys or operation command keys are available.
	1. to F.	• Failure detecting function "execution/stop" can be selected (setting items are selected using [FUNC] key). • Operations using data set keys or operation command keys are available.

5.2.1 Function Codes and Their Description in <MEAS.> Mode

Table 5.3 shows types of function code in <MEAS.> mode and their description.

Table 5.3 Functions List in <MEAS.> Mode

F	Description	Display Range	Display (example)	Initial Value (*1)	Remarks
1	Residual chlorine concentration display	-1.00 to 12.00 mg/l (O.L is displayed for out of range.)	0.35 mg/l	——	Display in ppm is also available.
2	Sample water temperature display	-5.0 to 55.0 °C (O.L is displayed for out of range.)	20.0 °C	——	
3	Applied voltage display	-1.50 to 1.50 V	-0.40 V	-0.40 (*2)	
4	Diffusion current display	-15.00 to 65.00 µA (O.L is displayed for out of range.)	2.62 µA	——	
5	Display for “%FS” of output signal	-10.0 to 110.0 %	50.0 %	——	
6	Display for sample water metering pump flow	0.0 to 100.0 ml/min	50.0 ml/min	0.0	
7	Display for reagent metering pump flow	0.00 to 3.00 ml/min	1.50 ml/min	0.00	
8	Zero point error display	-1.00 to 1.00 µA	0.02 µA	0.00	
9	Slope display	50.0 to 120.0 %	100.0 %	100.0	
A : F.	(Cannot be selected)				

(*1) Values shown in the initial value column are those shown when the memory that stores data is initialized.
(*2) In the case of combined chlorine insensitive version, the initial value is +0.6 V.

5.2.2 Function Codes and Their Description in <MAINT.> Mode

Table 5.4 shows the types of function code and their description in <MAINT.> mode.

Table 5.4 Functions List in <MAINT.> Mode

F	Description	Setting Range	Display (example)	Initial Value	Remarks
1	Zero calibration	0.00 mg/l (Display: -1.00 to 12.00)	000.02 mg/l		Display in ppm is also available.
2	Span calibration	0.00 to 10.00 mg/l (Display: -1.00 to 12.00)	004.02 mg/l		Display in ppm is also available.
3					
4	Manual start of measuring tank cleaning		"JEt"		
5	Manual start of sand filter cylinder-1 cleaning		"bLo_1"		
6	Manual start of sand filter cylinder-2 cleaning		"bLo_2"		
7	Sample water metering pump flow measurement		"FLo_1"		
8	Reagent metering pump flow measurement		"FLo_2"		
9	Taking plateau characteristics		"PLt_E"		
A	Plateau characteristics display		"PLt_d"		
b	Error code display		"CHEC"		
c	<FAIL> display/contact output reset		"CL_Er"		
d	Span calibration (reference sensitivity updating)		"CAL"		
E	Version number		1.02		
F	Entry of password for transferring to "service mode"		"_ _ _ 00"		Password "_ _ _ 77"
1. : F.	(These are usually not selected owing to "service mode".)				

Note 1: Message shown in the display example column shows the content shown first when the relevant function code is selected.
Note 2: If an unused function code is selected, "- - - - -" is displayed.

5.2.3 Function Codes and Their Description in <PROGRAM.1> Mode

Table 5.5 shows the types of function code and their description in <PROGRAM.1> mode.

Table 5.5 Functions List in <PROGRAM.1> Mode

F	Description	Setting Range	Display (example)	Initial Value	Remarks
1	Output range setting for "output range-1"	0.00 to 10.00 mg/l (Span 1.00 or more)	L00.00 mg/l	L00.00 H05.00	Display in ppm is also available.
2	Output range setting for "output range-2"	0.00 to 10.00 mg/l (Span 1.00 or more)	L00.00 mg/l	L00.00 H10.00	Display in ppm is also available.
3					
4	Reference sensitivity setting	1.00 to 5.00 µA/(mg/l)	002.62 µA/(mg/l)	2.62	
5	Applied voltage setting	-1.50 to 1.50 V	-00.40 V	-0.40 (*4)	
6	Parameter setting for response checking	0.1 to 10.0 min	0007.0 min	7.0	
7	Setting concentration for stable indication detection	0.01 to 2.00 mg/l	000.01 mg/l	0.01	Display in ppm is also available.
8	Setting time for stable indication detection	2 to 180 sec	00060 sec	60	
9	Output signal setting in the case of <failure>	-10 to 110 %	00000 %	0	
A	Line-segment function output setting	0 to 100 %	00050 %	50	
b	Concentration upper limit alarm setpoint setting	0.00 to 11.00 mg/l	011.00 mg/l	11.00	Display in ppm is also available.
c	Setting out-of-sample detection starting concentration	0.00 to 5.00 mg/l	000.10 mg/l	0.10	Display in ppm is also available.
d	Setting averaging coefficient (time constant)	1 to 20	00001	1	
E					
F					
1.	Range transfer selection	Remote/local	on/oFF	oFF	oFF at local
2.	Output range type (1 or 2) when local range transfer is selected.	(Range-1)/(Range-2)	_ _ 1/_ _ 2	_ _ 1	
3.	Provision of output signal hold in <MAINT.>, <PROGRAM.1> or <PROGRAM.2> mode	(Provided/not provided)	on/oFF	on	
4.	Output signal mode when <FAIL> contact signal is output	Hold/no hold/preset	_ _ 1/_ _ 2/_ _ 3	_ _ 2	
5.	Automatic zero calibration function “execution/stop”	Execution/stop	on/oFF	oFF (*5)	
6.					
7.					
8.	Selecting cleaning sequence to be used	(Sand filter single cylinder/double cylinders)	_ _ 1/_ _ 2	_ _ 1	
9.	Measuring tank cleaning function "execution/stop"		on/oFF	on	
A.	Sand filter cylinder cleaning function "execution/stop"		on/oFF	on	
b.	Out-of-sample detecting function "execution/stop"		on/oFF	on	
c.	Concentration display unit	(mg/l/ppm)	_ _ 1/_ _ 2	_ _ 1	
d.	Air pump operation in <MEAS.> mode		on/oFF	oFF	on: Always operates
E.	Negative (below-zero) display selection in <MEAS.> mode		on/oFF	oFF	on: If the value is below zero, “0.00” is displayed (* 6) (* 7)
F.	Below-4-mA output hold selection in <MEAS.> mode		on/oFF	oFF	on: If the value is below 4 mA, it is held at 4 mA (* 7)

Note 1: If an unused function code is selected, "- - - - -" is displayed.
Note 2: If a value outside the setting range is set, "not" is displayed (pressing [>] key returns the display to data display).
Note 3: Values shown in the initial value column are those to be shown when the memory that stores data is initialized.
(*4) In the case of combined chlorine insensitive version, the initial value is +0.6 V.
(*5) When option code “/AZC” is specified, the initial value is “on.”
(*6) If the value is below -1.00 mg/l, “O.L” is displayed, regardless of the setting.
(*7) The setting can only be enabled in <MEAS.> mode.

5.2.4 Function Codes and Their Description in <PROGRAM.2> Mode

Table 5.6 shows the types of function code and their description in <PROGRAM.2> mode.

Table 5.6 Functions List in <PROGRAM.2> Mode

F	Description	Setting Range	Display (example)	Initial Value	Remarks
1					
2					
3	Setting measuring tank cleaning cycle	0.1 to 24.0 hours	0001.0 hours	1.0	Applied to RC400G-3 analyzer only
4	Setting measuring tank cleaning time	0.1 to 25.0 min	0001.0 min	1.0	
5	Setting relaxation time after cleaning	0.1 to 25.0 min	0005.0 min	5.0 (3.0)	The value in ( ) is for RC400G-3 analyzer.
6	Setting and filter cylinder cleaning cycle	0.1 to 24.0 hours	0002.0 hours	2.0 (0.5)	The value in ( ) is for RC400G-3 analyzer.
7	Setting sand filter cylinder cleaning time	0.1 to 25.0 min	0001.0 min	1.0	
8	Setting substitution time	0.1 to 25.0 min	0006.0 min	6.0	Applied to RC400G-3 analyzer only
9	Setting cross time	0.1 to 25.0 min	0001.0 min	1.0	Applied to RC400G-3 analyzer only
A	Setting automatic zero calibration cycle	0.1 to 99.9 days	0010.0 days	10.0	
b	Setting automatic zero calibration preparation time	1 to 100 min	0010 min	10	
c	Setting automatic zero calibration relaxation time	1 to 100 min	0010 min	10	
d					
E					
F					
1.					
2.					
3.					
4.	Temperature compensation range exceeding detection function "execution/stop"		on/oFF	on	
5.	Residual chlorine concentration upper limit alarm function "execution/stop"		on/oFF	on	
6.					
7.					
8.					
9.					
A.					
b.					
c.					
d.					
E.					
F.					

Note 1: If an unused function code is selected, "- - - - -" is displayed.
Note 2: If a value outside the setting range is set, "not" is displayed (pressing [>] key returns the display to data display).
Note 3: Values shown in the initial value column are those to be shown when the memory that stores data is initialized.

5.3 Key Operation

5.3.1 Operation Key Types and Functions

(1) Mode Key ([MODE])

By pressing [MODE] key, the operation mode changes. The current operation mode is known through a mode lamp which is lit.

Mode is transferred in the order shown in Figure 5.2 every time the [MODE] key is pressed. However, when a function code other than “1” is selected in each mode, mode does not change for the first key operation and only the function code returns to “1”.

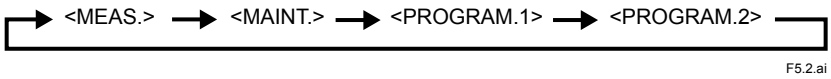
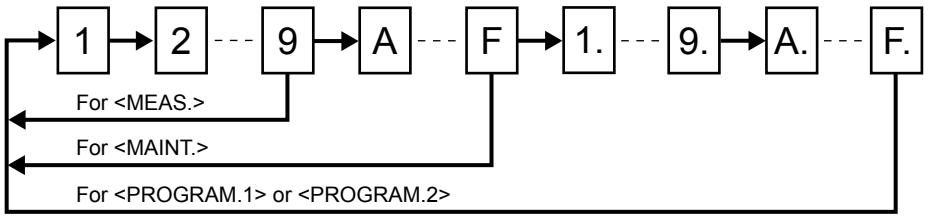


Figure 5.2 Mode Transfer by [MODE] Key Operation

(2) Function Key ([FUNC])

When [FUNC] key is pressed, the function code is transferred. The transferred function code is displayed in the function code display. Function code contents vary in each mode (see section 5.2). The number of selectable codes also varies in each mode.

Figure 5.3 shows how the function codes are transferred by [FUNC] key operation.



Note: By pressing [MODE] key with the function code set to other than “1”, the function code returns to “1”.

Figure 5.3 How the Function Codes are Transferred by [FUNC] Key Operation

(3) Data Set Keys

Operation using data set keys is valid in modes other than <MEAS.> mode. There are the following four types of data set key:

(a) [>] key (digit selection key):

This is used when a digit to be changed displayed in the data display is selected. The digit selected flashes. Digit selection is performed in such a manner as the digit moves from the most significant digit in the leftmost position to the right by one digit every time the key is pressed and returning from the right end to the left end.

(b) [Λ] key (numeric value increasing key):

The numeric value in the selected digit increments in turn every time this key is pressed and when it reaches 9 then next time it returns to 0. In the most significant digit, “-” (minus sign) is inserted next to 9. However, if negative numbers do not exist in the displayed data, that sign is not inserted.

(c) [v] key (numeric value decreasing key):

The numeric value in the selected digit decreases in turn every time this key is pressed and when it reaches 0 then next time it returns to 9. In the most significant digit, "-" (minus sign) is inserted next to 0. However, if negative numbers do not exit in the displayed data, that sign is not inserted.

(d) [ENT] key (entry key)

This is used for entering the displayed data. When data is entered, the entire displayed data flashes only once.

(4) Operation Command Keys-1

Operation of operation command keys-1 is valid in modes other than <MEAS.> mode.

Operation command keys-1 include the following three keys:

(a) [CELL] key (cell motor ON/OFF key):

The cell motor which operates the indicator electrode operates/stops every time this key is pressed. When the cell motor is stopped, <CELL> lamp which has lit during running extinguishes.

(b) [PUMP] key (metering pump ON/OFF key):

The sample water and reagent metering pumps operate/stop every time this key is pressed. When the metering pumps are stopped, <PUMP> lamp which has lit during running extinguishes.

(c) [AIR PUMP] key (air pump ON/OFF key):

For an analyzer which is provided with an air pump, the air pump operates/stops every time this key is pressed. When the air pump is stopped, <AIR PUMP> lamp which has lit during running extinguishes.

Even if the air pump is not provided, <AIR PUMP> lamp lights/extinguishes every time the key is pressed.

NOTE

If "on" is selected with function code "d." in <PROGRAM.1> mode, the air pump automatically operates when <MEAS.> mode is selected, even if the air pump operation is set to be stopped.

(5) Operation Command Keys-2

Operation of operation command keys-2 is valid in modes other than <MEAS.> mode. Operation command keys-2 include the following six keys shown in Table 5.7. These keys are for operating/stopping solenoid valves for the measuring tank and the sand filter cylinder cleaning.

Accordingly, none of these keys are used in the "the RC400G-1 residual chlorine analyzer for tap water" which does not incorporate cleaning functions for measuring tank and sand filter cylinder. Also, in "the RC400G-2 residual chlorine analyzer for raw water", although cleaning functions are provided, only [SV1] and [SV2] keys are used.

When a solenoid valve is operating, the relevant lamp lights. If, to whatever operating condition each solenoid valve state is changed using key operation, the normal state is restored by selecting <MEAS.> mode.

The relevant lamp to that key lights/extinguishes every time the relevant key is pressed, even when no solenoid valve is provided.

Table 5.7 Operation Command Keys-2 and Relevant Solenoid Valves

Operation Command Key	Relevant Solenoid Valve	RC400G-1 (no cleaning function)	RC400G-2 (number of sand filters: 1)	RC400G-3 (number of sand filters: 2)
SV1	SV1: Solenoid valve in one sand filter cylinder cleaning water line	x	A	A
SV2	SV2: Solenoid valve in measuring tank cleaning water line	x	A	A
SV3	SV3: Solenoid valve in one sand filter cylinder sample water line	x	x	A
SV4	SV4: Solenoid valve in two sand filter cylinder sample water line	x	x	A
SV5	SV5: Solenoid valve in two sand filter cylinder cleaning water line	x	x	A
SV6	Switching of automatic zero calibration solution/sample water	A (Note)	A (Note)	A (Note)

A: Relevant solenoid valve is provided.
x: Relevant solenoid valve is not provided.
Note: Provided when option code "/AZC" is specified.

5.3.2 Key Operation in <MEAS.> Mode

Each data in Table 5.3 is displayed by [FUNC] key operation. Those contents are described below in the order shown:

(1) Residual Chlorine concentration display (Function code "1")

(2) Sample water temperature display (Function code "2")

(3) Applied voltage display (Function code "3")

(4) Diffusion current display (Function code "4")

(5) Display for % FS of output signal (Function code "5")

(6) Display for sample water metering pump flow rate (Function code "6")

(7) Display for reagent meter pump flow rate (Function code "7")

(8) Zero point error display (Function code "8")

(9) Slope display (Function code "9")

(1) Residual Chlorine Connection Display (Function code "1")

Function code "1" displays residual chlorine concentration of -1.00 to 12.00 mg/l (or ppm).

The unit is represented by "mg/l" or "ppm" selected using the function code "c." in <PROGRAM.1> mode.

(2) Sample Water Temperature Display (Function code "2")

Function code "2" displays sample water temperature in the range of -5.0 to 55.0 °C.

The temperature sensor used for measuring sample temperature is a Pt 1000 RTD incorporated in the counter electrode.

(3) Applied Voltage Display (Function code "3")

Function code "3" displays an applied voltage across the electrodes. The applied voltage is set using function code "5" in <PROGRAM.1> mode.

(4) Diffusion Current Display (Function code “4”)

Function code “4” displays a diffusion current in the range of -15.00 to 65.00 µA.

However, if the limit of “output range-1” and “output range-2”, whichever is greater, is set at 5.00 mg/l (ppm) or lower, the maximum displayed value is approx. 35 µA because the current input range is set to “Low” (approx. -5 to 35 µA).

When the diffusion current exceeds a value corresponding to 5.00 mg/l, “O.L” is displayed.

NOTE

For the current input range, see subsection 6.1.1.

(5) Display for “%FS” of Output Signal (Function code “5”)

Function code “5” displays what percentage of the selected output range span the current residual chlorine concentration measured value corresponds to. The display range is -10.0 to 110.0 %.

(Example) For output range: 0 to 3 mg/l, Current residual chlorine concentration measured value: 0.54 mg/l;

Display for “%FS” of output = 0.54 / (3-0) x 100 = 18.0 (%)

The analog output is sent out in the range of -10.0 to 110.0 %.

(6) Display for Sample Water Metering Pump Flow (Function code “6”)

Function code “6” displays the sample water metering pump delivery flow rate. This flow rate displayed value is that computed from the result of operation conducted using function code “7” in <MAINT.> mode (see subsection 4.3.5).

Hence, if operation is not conducted even once, “0.00 ml/min” is displayed.

(7) Display for Reagent Metering Pump Flow (Function code “7”)

Function code “7” displays the reagent metering pump delivery flow rate. This flow rate displayed value is that computed from the result of operation conducted using function code “8” in <MAINT.> mode (see subsection 4.3.6).

Hence, if operation is not conducted even once, “0.00 ml/min” is displayed.

(8) Zero Point Error Display (Function code “8”)

Function code "8" displays the diffusion current (µA) obtained in the latest zero calibration. Since the zero point reference diffusion current is 0 µA, this value shows the zero point error.

If the diffusion current in zero calibration exceeds the range of -1.0 to 1.0 µA, an error message of "Err21" is issued.

(9) Slope Display (Function code “9”)

Function code "9" displays the sensitivity in % obtained in the latest span calibration to the reference sensitivity.

If the sensitivity decreases below 50 % of the reference sensitivity in span calibration, an error message of "Err22" is issued.

NOTE

The reference sensitivity which has been set on shipment is the value "2.62 µA/(mg/l) at 20 °C" based on the amperometric titration.

5.3.3 Key Operation in <MAINT.> Mode

This subsection describes key operations to be conducted by specifying function codes in <MAINT.> mode and displays associated with the key operations.

(1) Zero calibration (Function code “1”)

(2) Span calibration (Function code “2”)

(3) Span calibration (reference sensitivity updating) (Function code “d”)

(4) Manual start of measuring tank cleaning and sand filter cylinder cleaning (Function code “4”, “5”, and “6”)

(5) Measurement of sample water and reagent metering pump flow (Function code “7” and “8”)

(6) Taking plateau characteristics (Function code “9”)

(7) Plateau characteristics display (Function code “A”)

(8) Error code display (Confirmation of <FAIL> contents) (Function code “b”)

(9) <failure> display/contact output resetting (Function code “c”)

(10) Version number display

(11) Password input for transferring to the “service mode” (Function code “F”)

(1) Zero Calibration (Function code “1”)

There are two methods for calibrating the residual chlorine analyzer: one is the method to be performed with input open circuit and the other is the method to be conducted using chlorine-free water. For details, see section 7.2 “Zero Calibration”. In this subsection, the key operation for it is described.

Calibration operation starts at key operation. The procedure for key operation is as follows:

	(Example)
(a) Select function code “1” in <MAINT.> mode.	=> 000.24 mg/l
(b) Press [ENT] key. (<CAL> lamp starts flashing.)	
• Indication stability is checked.	=> 000.03 mg/l
• When stabilized, the entire display flashes once and the calibration is performed.	=> 000.00 mg/l
<CAL> lamp extinguishes at the same time.	

If [ENT] key is pressed before stabilization is judged to be completed, calibration is performed at that instant.

When indication is stable, zero point error is examined and if it is out of permissible range, the following message is displayed:

“Err21” (zero point failure in calibration)

If indication is not stabilized within the predetermined time, the following message is displayed:

“Err23” (response failure in calibration)

In either case, only the message is displayed and no lighting of <FAIL> lamp and no output of <FAIL>contact signal occur.

The error message display is reset by pressing [ENT] key returning to the residual chlorine concentration display.

The criteria for zero point failure and response failure are as shown in Table 5.8.

Table 5.8 Failures in Zero Calibration and Their Criteria

Failure	Criteria
Zero point failure	Diffusion current exceeding the range -1 to 1 µA (fixed)
Response failure	Stabilizing time exceeding the setpoint (set using function code "6" in <PROGRAM.1> mode). Set at 7 min on shipment.

In any stage of zero point calibrating operation, transferring to other modes or function codes is available by pressing [MODE] key or [FUNC] key. However, unless calibration is completed, the calibrating operation conducted before becomes invalid.

(2) Span Calibration (Function code “2”)

Span calibration is performed using a standard calibration solution. For details, see section 7.3 “Span Calibration”. In this subsection, key operation for it is described.

First set the residual chlorine concentration in the standard calibration solution and then start the calibration operation. The key operation procedure is as follows:

(Example)

(a) Select function code “2” in <MAINT.> mode. → 000.46 mg/l

(b) Press [>] key. → 000.46 mg/l
(The most significant digit flashes.)

(c) Select a digit to be set by pressing [>] key.and set the calibration concentration using [Λ] and [v] keys. → 000.57 mg/l
(The last set digit flashes.)

(d) Press [ENT] key. (<CAL> lamp starts flash.) → 000.48 mg/l
(Current concentration)

If calibration concentration setpoint is out of the permissible range, the following message is displayed: "not" (setpoint failure)

The message is reset by pressing [>] key and the display returns to the indication in (b).

- Indication stability is checked. → 000.54 mg/l
- When stabilized, the entire display flashes once and the calibrated. → 000.57 mg/l
  At the same time <CAL> lamp extinguishes.

If [ENT] key is pressed before stabilization judgment, calibration is performed at that instant.

When indication is stable, the sensitivity is examined and if it is out of permissible range, the following message is displayed:

"Err22" (sensitivity failure in calibration)

If indication is not stabilized within the predetermined time, the following message is displayed:

"Err23" (response failure in calibration)

In either case, only the message is displayed and no lighting of <FAIL> lamp and no output of <FAIL> contact signal occur.

The error message display is reset by pressing [ENT] key returning to the residual chlorine concentration display.

The criteria for setpoint failure, response failure, and sensitivity failure are as shown in Table 5.9.

Table 5.9 Failures in Span Calibration and Their Criteria

Failure	Criteria
Setpoint failure	Setpoint exceeding the range of 0.00 to 10.00 mg/l (ppm) (fixed)
Response failure	Stabilizing time exceeding the setpoint (set using function code "6" in <PROGRAM.1> mode). Set at 7 min on shipment.
Sensitivity failure	Ration to the reference sensitivity decreasing below 50 % (fixed)

In any stage of span calibrating operation, transferring to other modes or function codes is available by pressing [MODE] key or [FUNC] key. However, unless calibration is completed, the calibrating operation conducted before becomes invalid.

Table 5.10 summarizes error messages displayed in zero point and span calibration and their detecting conditions for reference.

Table 5.10 Error Messages displayed in Zero and Span Calibration

Error Message	Error Contents	Permissible Range	Range Setting	Resetting
Err21	Zero point failure	-1.0 to 1.0 µA	Fixed	[ENT] key
Err22	Sensitivity failure (Note)	50 % or more of reference sensitivity	Fixed	[ENT] key
Err23	Response failure	Setpoint	Variable	[ENT] key
not	Calibration value setting failure	0.00 to 10.00 mg/l	Fixed	[>] key

Note:
- The reference sensitivity set on shipment is the value of 2.62 µA/(mg/l) at 20 °C based on amperometric titration.
- In the case that, for example, a standard solution whose residual chloric concentration is low is measured by manual analytical methods other than amperometric titration (colorimetry, iodometric titration), an error may occur even if sensitivity is normal because of the difference in sensitivity owing to manual analysis.
- If calibration is impossible because of error, automatically update the reference sensitivity using the next operation (3) or change the reference sensitivity according to the manual analysis adopted using the method shown in subsection 5.3.4 (2).

(3) Span Calibration (Reference Sensitivity Updating) (Function code “d”)

If span calibration is executed with function code set to “d”, the reference sensitivity set in function code “4” in <PROGRAM.1> mode is automatically updated.

Since the RC400G residual chlorine analyzer is calibrated for span using the amperometric titration in the factory, the reference sensitivity on shipment is also set to “2.62 µA/(mg/l) at 20 °C” based on amperometric titration.

When a problem occurs, for example, the error message “Err22” display appears in the case of measuring residual chlorine concentration in a standard solution using a manual analysis other than amperometric titration, once execute span calibration accompanied by this reference sensitivity updating.

NOTE

Manual setting of reference sensitivity, such as modification of updated sensitivity, should be performed using function code “4” in <PROGRAM.1> mode. (See subsection 5.3.4)

Key operation procedure is as follows:

(Example)

(a) Select function code “d” in <MAINT.> mode. → CAL

(b) Press [ENT] key. → 000.46 mg/l

(Subsequent procedure is the same as operations (b) in (2) Span Calibration.)

(4) Manual Start of Measuring Tank Cleaning and Sand Filter Cylinder Cleaning (Function codes “4”, “5”, and “6”)

By specifying a predetermined function code and pressing [ENT] key, cleaning of the measuring tank and sand filter cylinder(s) can be executed.

WARNING

Electric Shock Hazard

Even if the cleaning system tubing is not provided, manual cleaning start command operation is available. Exercise care to prevent electric shock since solenoid valve driving power is applied to predetermined terminals by start command operation.

Key operations for start command are common to cleaning of each item.

Cleaning operation time is the same as that set in function codes in <PROGRAM.2> mode.

Key operation procedure is shown below.

(a) Select function code “4”, "5", or "6" in <MAINT.> mode.
The data display indicates as shown below. (Example)
Function code "4" (measuring tank cleaning) : "JEt"
Function code "5" (sand filter cylinder-1 cleaning) : "bLo_1"
Function code "6" (sand filter cylinder-2 cleaning) : "bLo_2"

(b) Press [ENT] key. (<WASH> lamp starts to flash.) → 59 (sec)
(Decreases with time lapse.)

- Cleaning action starts and the operation display lamp corresponding to the active solenoid valve lights.
- Data display indicates time (unit: sec) and elapsed time is counted down.
- When set cleaning operation time is over, <WASH> lamp extinguishes and cleaning operation is completed. → "End"

If [ENT] key is pressed after cleaning operation is completed, the status returns to (a).

If [ENT] key is pressed during cleaning operation, the cleaning operation is aborted at that time. Also, if one of the other modes or functions is selected using [MODE] key or [FUNC] key, the cleaning operation is aborted.

During cleaning, operation of the operation command keys ([SV1] key or others) is invalid.

Table 5.11 shows setting and operation items related to manual cleaning start command.

Table 5.11 Setting and Operation Items Related to Manual Cleaning Start Command

Function Code	Cleaning Object	Time Setting Mode	Time Setting Function	Set Time on Shipment	Solenoid Valve to be Operated
4	Measuring tank cleaning	PROGRAM.2	4	One minute	SV2
5	Sand filter cylinder-1 cleaning		7	One minute	SV1
6	Sand filter cylinder-2 cleaning		7	One minute	SV5

(5) Measurement of Sample Water and Reagent Metering Pump Flow (Function code “7” and “8”)

Metering pump delivery flow rates are measured by measuring the time (sec) during which each metering pump delivers the predetermined volume. When the time is measured, the converter computes the flow rate (ml/min) using this time and displays the results.

The sample water metering pump delivery volume is measured using function code “7” and the reagent metering pump delivery volume using function code “8”. Key operation for time measurement is the same for both metering pumps.

Key operation procedure is described below.

(a) Prepare for measurement according to subsection 4.3.5 (or subsection 4.3.6).

(b) Select function code “7" or "8" in <MAINT.> mode.

The data display indicates as shown below. (Example)

Function code "7" (sample water) : "FLo_1"

Function code "8" (reagent) : "FLo_2"

(c) Re-actuate metering pumps stopped for measurement preparation.

(d) Measure the delivery time required for 150 ml of sample water or 4.5 ml of reagent from the metering pump.

- When the liquid level within a metering apparatus (such as graduated cylinder) reaches the reference graduation, press [ENT] key. Time measurement starts (data display indication changes to time indication). → 1 (sec)
- When the liquid level reaches the predetermined graduation position, press [ENT] key again.

  Time measurement stops. → 186 (sec)

  The indicated time flashes once and the flow rate is calculated and displayed. → 48.4 ml/min

  If the time measurement does not reach 90 sec, "O.L" is displayed. If [ENT] key is not pressed even after 360 sec have elapsed, "Error" is displayed. These displays are reset by pressing [ENT] key and the message in operation step (b) appears.

(e) After the flow rate is displayed and confirmed normal, restore tubing and the like.

Time to be measured and computable flow rate ranges are as shown in Table 5.12.

Table 5.12 Measurement Flow Rate and Time Ranges

Measuring Item	Computable Flow Rate Range	Measurement Time Range
Sample water flow rate Reagent flow rate	25.0 to 100.0 ml/min 0.75 to 3.00 ml/min	90 to 360 sec

(6) Taking Plateau Characteristics (Function code “9”)

Function code "9" performs parameter setting and execution commanding for taking plateau characteristics.

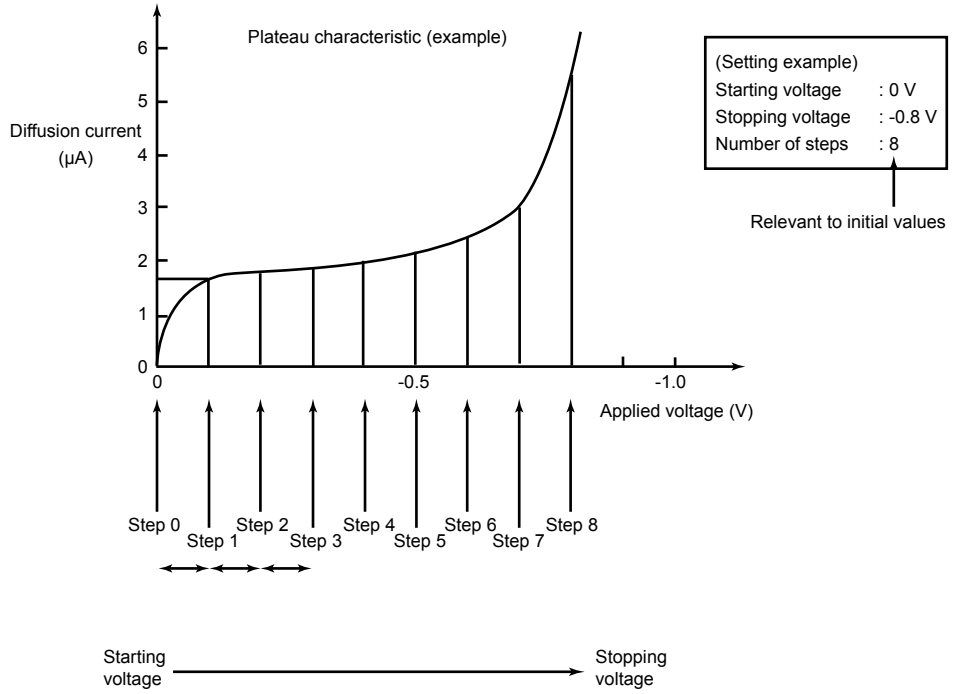
When execution is commanded after start and stop voltages for applied voltage and the number of steps are set, applied voltage corresponding to set parameters are applied in turn and plateau characteristics (voltage-current characteristic) taken. The time required for taking a plateau characteristic is approx. 2 or 3 min per step, although it varies depending on the number of steps set and the voltage.

NOTE

Applied voltage changes during taking of plateau characteristic. Hence, if analog output hold is reset in maintenance (<MAINT.>, <PROGRAM.1> and <PROGRAM.2>), the output changes corresponding to the set output range.

Thus, the status of current change is replaced with residual chlorine concentration change and this can be output to a recorder or the like utilizing the above phenomenon. Set the output range at an appropriate value depending on plateau characteristics.

Figure 5.4 shows the relationship between start to stop voltage and the number of steps.



Note
- The applied voltage changes in the direction of increasing negative voltage.
- The number of diffusion current samples is “the number of steps plus one”.
- Applied voltage at each step are computed automatically when executed.

T6.4.ai

Figure 5.4 Example of Taking Plateau Characteristics

The key operation procedure for <taking plateau characteristic> is as follows:

			(Example)
(a)	Select function code “9" in <MAINT.> mode.	→	PLt_E (Display)
(b)	On pressing [ENT] key, the starting voltage is displayed.	→	L00.00 V
(c)	To change the setting, press [>] key.	→	L00.00 V
	(If no setting change is required, operate from step (e).)		(Leftmost digit flashes.)
(d)	Select a digit using [>] key and set the numeric value using [Λ] and [>] keys.	→	L00.10 V
	Pressing [ENT] key now fixes the numeric value.		(Last set digit flashes.)
(e)	Press [ENT] key to display the stopping voltage.	→	H-1.00 V
(f)	To change the setting, press [>] key.	→	H-1.00 V
	(If no setpoint change is required, start from step (h).)		(Thenegative sign flashes.)
(g)	Select a digit using [>] key and set the numeric value using [Λ] and [>] keys.	→	H-0.80 V
	By next pressing [ENT] key, the numeric value is fixed.		(Last set digit flashes.)
(h)	On pressing [ENT] key, the number of steps is displayed.	→	P0010
(i)	To change the setting, press [>] key.	→	P0010
	(If no setpoint change is required, start from step (k).)		(Leftmost numeral flashes.)
(j)	Select a digit using [>] key and set the numeric value using [Λ] and [>] keys.	→	P0008
	Pressing [ENT] key now fixes the numeric value.		(Last set digit flashes.)
(k)	Pressing [ENT] key displays "Execution selection".	→	Go_oF
	If each setpoint is to be reconfirmed, press [ENT] key.		
	The display returns to (b) starting voltage display.		
(l)	If the displayed item is to be executed, press [>] key.	→	Go_on

(m) On pressing [ENT] key, characteristic taking is executed.

- Data taking proceeds in turn by displaying the step No. and time lapse.

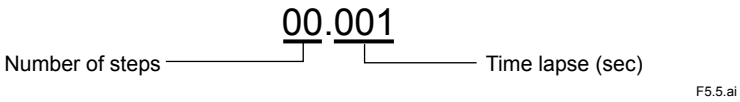


Figure 5.5 Display Content in Taking Plateau Characteristic

- Data taking at a step is over, the next step display appears. Time lapse display is also reset and counts up from the beginning.

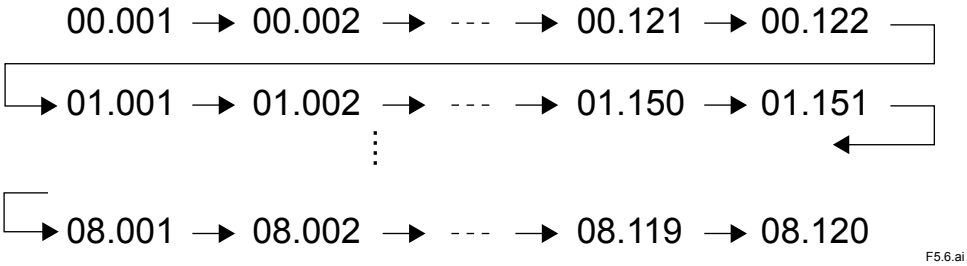


Figure 5.6 Status of Display Change in Taking Plateau Characteristic

- When the last step is completed, data taken is stored in memory. Several sec are required to complete string. → Stor (Display)
- When completed, "End" is displayed. → End
  (If data is to be retakes, press [ENT] key. The display returns to the status of (a).)

The above demonstrated the plateau characteristic taking operation including that for changing setting contents.

Here the notable points in setting data are summarized. Permissible ranges for each setpoint are as shown in Table 5.13.

Table 5.13 Permissible Ranges and Initial Values for Plateau Characteristic Taking Setpoints

Setting Item	Permissible Range (fixed)	Detection Timing	Initial Value
Starting voltage Stopping voltage Number of steps	1.50 to -1.50 V 1.50 to -1.50 V 1 to 20 steps	When [ENT] key is pressed after each setpoint is changed	0 V -0.8 V 8

When a setpoint exceeds the permissible range, “not" is displayed. Reset it by pressing [>] key. By resetting, the display returns to the data value before change.

In addition, the starting voltage must be set to be larger than the stopping voltage and also the setting width must be larger than 0.1 V.

Starting Voltage − 0.1 V > Stopping Voltage

These set data are checked the instant [ENT] key is pressed with "execution selection" display set to ON. If the conditions are not met, an error message of "not" appears. The error message is reset by pressing [>] key. By pressing [>] key, the display returns to "Go_oF" display. Then, change the voltage setpoint.

The operating procedure when taking plateau characteristic with the same setting contents as the previous time is shown below.

(Example)

(a) Select function code “9" in <MAINT.> mode. → PLt_E
(b) On pressing [ENT] key, the starting voltage is displayed. → L00.00 V
(c) On pressing [ENT] key, the stopping voltage is displayed. → H-0.80 V
(d) On pressing [ENT] key, the number of steps is displayed. → P0008
(e) Pressing [ENT] key displays "Execution selection". → Go_oF
(f) Pressing [>] key displays "Executable". → Go_on

(g) On pressing [ENT] key, characteristic taking is executed. → 00.001

When a series of taking operations is completed, "End" is displayed.
→ End

During plateau data taking, any step can be skipped and data taking is transferred to the next step.

This operation is performed using [ENT] key. When [ENT] key is pressed, the step display then displays the next step number and the time display is also reset to start the next step time counting. No plateau data for the skipped step is taken.

During plateau data taking at any step, the operation can be suspended using [MODE] and [FUNC] keys. In this case, operations from start to the suspended step all become invalid. However, since those key operations cannot be accepted when "Stor" is displayed, data taken is updated.

When plateau characteristic taking operations are completed (or aborted), the applied voltage to the electrode returns to the automatically set value (function code "5" in <PROGRAM. 1> mode). When this operation is complete, residual chlorine concentration measured value is temporarily unstable immediately after applied voltage change.

If the current value fails to stabilize in the predetermined time during taking plateau characteristics, the diffusion current value at the predetermined time lapse is sampled. The predetermined time described above is the same as "response time limit" to be described in subsection 5.3.4(3).

Table 5.14 shows the possible error message that may be issued when taking plateau characteristics and its contents.

Table 5.14 Error in Taking Plateau Characteristics

Error Message	Error Content	Reset
not	Starting and stopping voltage failures, number of steps setpoint failure and starting and stopping voltage setting width failure.	[>] key

(7) Plateau Characteristics Display (Function code “A”)

When function code is set to "A", the plateau characteristic taken by function code "9" operation is displayed. The plateau characteristic display contents include each step number, applied voltages at each step, and the diffusion current value.

Key operations for displaying plateau characteristics are shown in the following:

(a) Select function code “A" in <MAINT.> mode. → PLt_d (Display)
(b) On pressing [ENT] key, a step number is displayed. → P_ _00
(c) On pressing [>] key, the applied voltage at that step is displayed. → 00.000 V
(d) On pressing [>] key, the diffusion current at that step is displayed. → 000.00 µA
(e) Next, by pressing [>] key, the display returns to the step number display. → P_ _00
(Steps (c) to (e) can be repeated using [>] key.)
(f) On pressing [ENT] key with the step number displayed, the procedure moves to the next step. → P_ _01
(g) Applied voltages and diffusion currents are displayed by repeating operations (c) to (f).
(h) When the final step is reached, the next step returns to step "0".

If no plateau characteristics have been taken, "noP" is displayed when [ENT] key is pressed at step (b) of the operating procedure. If a step is skipped in taking plateau characteristic, the diffusion current display becomes "no_uP" because of data lack at that step.

Figure 5.7 shows an example of key operations for plateau characteristics display (number of steps: 8).

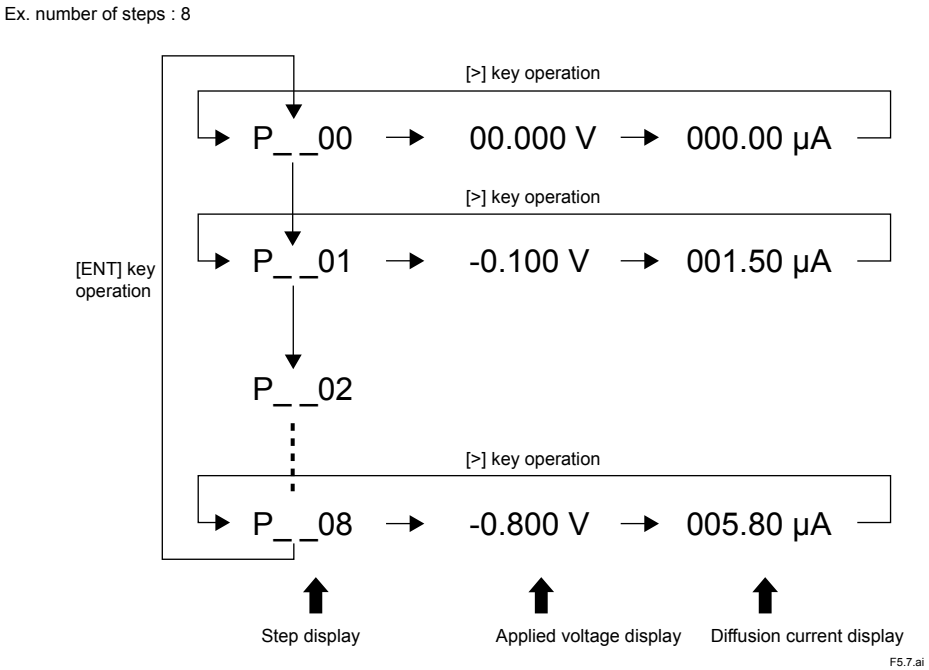


Figure 5.7 Key Operations for Displaying Plateau Characteristics

(8) Error Code Display (Function code “b”)

When <FAIL> lamp is lit on detecting a failure during operation, the generated <failure> contents can be confirmed by error code display.

Note: For countermeasures when failure occurs, see chapter 9 "Troubleshooting".

Key operations for displaying error codes are shown below:

(Example)

(a) Select function code “b" in <MAINT.> mode. → CHEC (Display)

(b) On pressing [ENT] key, an error generated is displayed. → Err13 (Flashing)

(If more than one error exists, these error codes are displayed flashing in turn.)

If no error exists, "Good" is displayed.

(c) On pressing [ENT] key, the display returns to "CHEC" display. → CHEC

Table 5.15 shows the types of <failure> for which <FAIL> lamp lights and the detecting conditions.

When these <failures> occur, a contact signal is output from the external connecting terminals F1 and F2. However, as shown in Table 5.15, the contact signal is output only in the determined modes.

Table 5.15 Types of <failure> for Which <FAIL> Lamp Lights

Error Code	<failure> Contents	Detecting Conditions	Detectable Mode	Mode in which <failure> Contact Signal is Output	Selection of Detecting Function "stop"
Err11	Concentration range exceeded	Out of -0.5 to 11.0 mg/l range	All modes	<MEAS.>	Unavailable
Err12	Sample temperature failure	Out of 0 to 50 °C range	All modes	<MEAS.>	Unavailable
Err13	Out-of-sample in the measuring tank		<MEAS.>	<MEAS.>	Available
Err14	Converter failure	(AD circuit failure)	All modes	All modes	Unavailable
Err15	Converter failure	(Memory comparison failure)	All modes	All modes	Unavailable
Err16	Converter failure	(Memory R/W failure)	When power is turned ON	When power is turned ON	Unavailable
Err17	Converter failure	(Memory R/W failure)	When power is turned ON	When power is turned ON	Unavailable
Err24	Temperature compensation range exceeded	Out of 0 to 40 °C range	All modes	<MEAS.>	Available
Err25	Concentration upper limit setpoint exceeded	When setpoint is exceeded	All modes	<MEAS.>	Available

Types of <failure> to be detected include those which are only displayed without <FAIL> lamp lighting and <failure> contact signal output.

These types of <failure> are shown in Table 5.16.

Table 5.16 <failure> Accompanied by Error Message Only

Error Message	<failure> Contents	Detecting Conditions	Operation in which the Error is Detected
Err21	Zero point failure	Out of -1.0 to 1.0 µA range	Zero calibration
Err22	Sensitivity failure	Less than 50 % of reference sensitivity	Span calibration
Err23	Response failure	When setpoint is exceeded	Zero and span calibration
Error	Flow rate failure	When six minutes is exceeded	Measurement of metering pump flow rate
not *1	Setpoint range exceeded	When the permissible range is exceeded	Data setting operation

*1: For permissible range for exceeding the setpoint range, see Table 5.5 and others.

(9) <failure> Display/Contact Output Resetting (Function code “c”)

Once detected, <failure>s shown in Table 5.15 are not automatically reset even if the cause is removed.

When failed parts are returned to normal, reset <FAIL> lamp lighting and <failure> contact signal output through the following operations:

(a) Select function code “c" in <MAINT.> mode. → CL_Er (Display)

(b) Press [ENT] key. → (flashes once.)

- <FAIL> lamp extinguishes. When the <failure> contact signal is output, this output is turned OFF.

If <FAIL> lamp again lights after an error is reset, it indicates that the failed part is not yet restored. Take countermeasures again referring to the chapter 9 on troubleshooting.

(10) Version Number Display

Select function code "E" in <MAINT.> mode, then the converter-incorporated ROM version number is displayed.

(11) Entry of Password for Transferring to “Service Mode” (Function code "F")

Function codes "1." to "F." in <MAINT.> mode are provided as function codes in "service mode" used when YOKOGAWA performs servicing.

These function codes can be selected by entering the password (77) in function code "F".

However, request servicing by YOKOGAWA as a rule if operations are required in "service mode".

5.3.4 Key Operations in <PROGRAM.1> Mode

In <PROGRAM.1> mode, setting operation for various data values such as output range can be performed. Also, selecting operation for various actions such as range selection can be conducted.

Function code “1” to “F” → Data setting

Function code “1.” to “F.” → Action selection

For specific contents, see Table 5.5.

This subsection describes key operations to be performed by specifying function codes in <PROGRAM.1> mode and displays accompanying such key operations.

(1) Output range setting (Function code “1”, “2”)

(2) Reference sensitivity setting (Function code “4”)

(3) Applied voltage setting (Function code “5”)

(4) Parameter setting for response checking (Function code “6”, “7”, and ”8”)

(5) Output signal setting in the case of <failure> (Function code “9”)

(6) Line-segment function output setting (Function code “A”)

(7) Concentration upper limit alarm setpoint setting (Function code “b”)

(8) Out-of-sample detection concentration setting (Function code “c”)

(9) Setting averaging coefficient (time constant) (Function code "d")

(10) Range switching (“remote/local”) selection (Function code “1.”, “2.”)

(11) Output mode (“Hold/No Hold”) selection in maintenance (Function code “3.”)

(12) Output signal mode selection in <failure> (Function code “4.”)

(13) Selection of automatic zero calibration function “execution/stop” (Function code “5.”)

(14) Selection of cleaning sequence to be used (Function code “8.”)

(15) Selection of measuring tank cleaning function “execution/stop” (Function code “9.”)

(16) Selection of sand filter cylinder cleaning function “execution/stop” (Function code “A.”)

(17) Selection of out-of-sample detecting function “execution/stop” (Function code “b.”)

(18) Concentration display unit selection (Function code “c.”)

(19) Selection of air pump action function “execution/stop” (Function code “d.”)

(20) Selection of negative (below-zero) display in <MEAS.> mode (Function code “E.”)

(21) Selection of below-4-mA output hold in <MEAS.> mode (Function code “F.”)

(1) Output Range Setting (Function code “1”, “2”)

Analog output signals include “output range-1” and “output range-2”. Either of them can be arbitrarily output.

Function code “1” sets the range of “output range-1” and function code “2” sets the range of “output range-2”.

In the following, key operations for range setting are shown. The key operation procedure is the same both in output range-1 and output range-2.

			(Example)
(a)	Select function code "1" (or "2").	→	L00.00 mg/l (Lower limit value display)
(b)	On pressing [>] key, the lower limit value can be entered. (If change is not required, start operation at step (d).)	→	L00.00 mg/l (Leftmost numeral flashes.)
(c)	Select a digit using [>] key, set a numeric value limit value using [Λ] and [>] keys.	→	L01.00 mg/l (Last setting digit flashes.)
(d)	On pressing [ENT] key, the upper range value is displayed. (If change is not required, start operation at step (f)).	→	H05.00 mg/l
(e)	Change the numeric value in the same operation as shown in step (b) and (c).	→	H03.00 mg/l
(f)	On pressing [ENT] key, setting is performed.	→	H03.00 mg/l (The display once flashes.)

(On repressing [ENT] key, the step is returned to (a). Confirm the set value.)

If both the upper and lower limit values are not to be changes, only confirmation operation of the set values is performed. Thus, when operation of step (f) is executed, the display does not flash.

The permissible setting range is 0.00 to 10.00 mg/l for both the upper and lower limit values. However, span (= “upper limit value” - “lower limit value”) must be 1.00 mg/l or more.

If a setting that does not meet the conditions is performed, “not” is displayed. Reset this display using [>] key and set again.

Permissible span range is checked when the upper limit value is set (operation procedure step (f)).

Table 5.17 shows the initial values of “output range-1” and “output range-2”.

Table 5.17 Initial Values of Output Ranges -1 and -2

Output Range	Lower Limit Initial Value	Upper Limit Initial Value
1	0.00 mg/l	5.00 mg/l
2	0.00 mg/l	10.00 mg/l

(2) Reference Sensitivity Setting (Function code “4”)

NOTE

Products which can be set using this function code are those of “version 1.02” or later. In products earlier than version 1.02, use the function code “7.” in service mode.

The reference sensitivity set on shipment is the value of “2.62 µA/(mg/l) at 20 °C” based on amperometric titration.

In span calibration, if standard solution residual chlorine concentration measured by manual analytical methods other than amperometric titration (such as chlorimetry and iodometric titration) is entered, great variance may occur between the sensitivity calculated from this value (measured sensitivity) and the set reference sensitivity. In particular, this trend is stronger when residual chlorine concentration is low or a sample water is used as the standard solution.

The RC400G residual chlorine analyzer detects an error (“Err22”) when the measured sensitivity is less than 50 % of the reference sensitivity and makes that span calibration invalid.

If it is found that inconvenience such as calibration is not performed because of the error (“Err22”) occurrence is caused by the difference between the employed method and manual analytical methods, set a reference sensitivity conforming to the employed manual analytical method.

NOTE

If “Err22” is not detected on adopting a manual analytical method other than amperometric titration, it is unnecessary to change the reference sensitivity.

Next, the key operation procedure for setting the reference sensitivity is described.

(a) Select function code "4". → 002.62 µA
(b) Select [>] key and set a numeric value using [Λ] and [v] keys. → 002.02 µA
(c) On pressing [ENT] key, setting is fixed. → 002.00 µA
(Entire display flashes once.)

When span is calibrated after resetting the reference sensitivity, the slope value displayed by function code “9” in <MEAS.> mode is updated to a value calculated based on the newly set reference sensitivity.

When span calibration is executed using function code “d” in <MAINT.> mode, the reference sensitivity is automatically updated.

If the reference sensitivity to be set is unclear, it is convenient to use this function.

(3) Applied Voltage Setting (Function code “5”)

This function sets a voltage to be applied across the electrodes. The key operation procedure for setting is as follows:

(a) Select function code "5". → -00.40 V
(b) Press [>] key. → -00.40 V
(Negative sign flashes.)
(c) Select the digit using [>] key and set a numeric value using [Λ] and [v] keys. → -00.50 V
(Last setting digit flashes.)
(d) Press [ENT] key to enter it. → -00.50 V
(Entire display once flashes.)

The permissible applied voltage setting range is -1.50 to 1.50 V. Since “not” is displayed for out-of-range settings, reset this display using [>] key to set it again. When an applied voltage is changed, it takes some time until indication is stabilized. Exercise care for this fact when transferring to <MEAS.> mode.

(4) Parameter Setting for Response Checking (Function code “6”, “7”, and ”8”)

This function sets parameters for detecting stability judgment and response failure automatically executed when calibration is to be performed and when plateau characteristics are to be taken.

Table 5.18 shows parameters to be set. When plateau characteristics are to be taken, response failure (Err23) detection is not conducted.

Table 5.18 Parameters for Response Checking

Function Code	Setting Content	Permissible Setting Range
6	Response time limit	0.1 to 10.0 min
7	Concentration for detecting indication stabilization	0.01 to 2.00 mg/l
8	Detecting time for detecting indication stabilization	2 to 180 sec

Figure 5.8 shows the judgment method for indication stabilization.

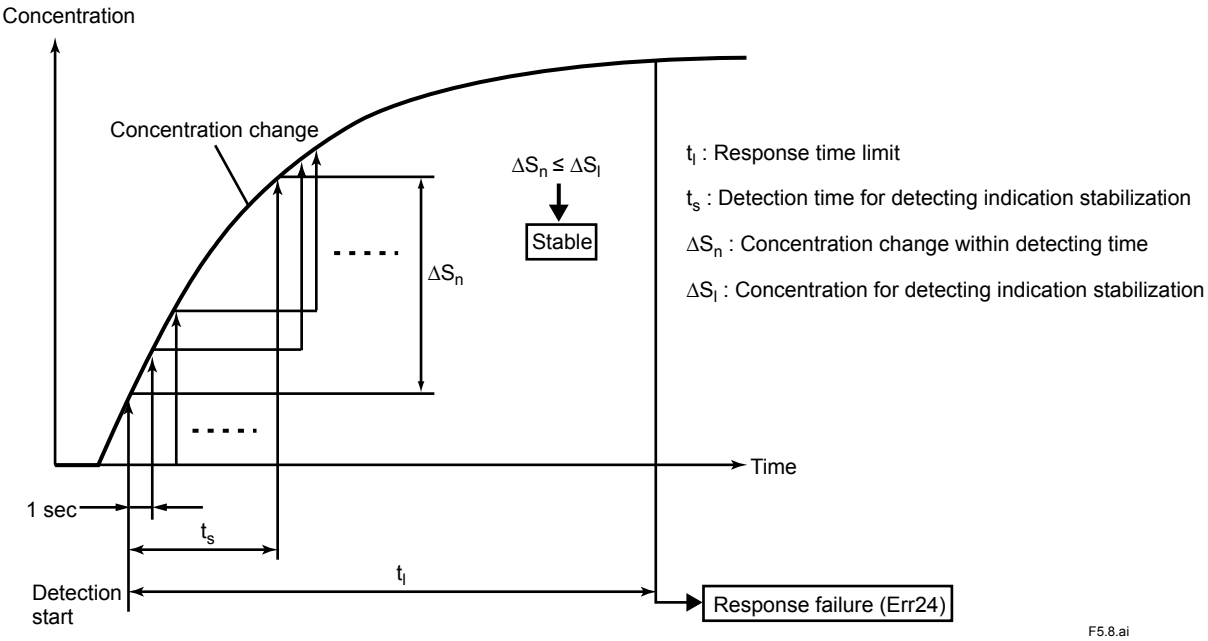


Figure 5.8 Judgment Method for Indication Stabilization

The setting key operation procedure is common to each parameter.

The following shows the procedure taking “response time limit” setting as an example:

(a) Select function code "6". → 0005.0 (min)

(b) Press [>] key. → 0005.0 (min)
(Leftmost digit flashes.)

(c) Select the digit using [>] key and set a numeric value using [Λ] and [v] keys. → 0006.0 (min)
(Last set digit flashes.)

(d) Press [ENT] key to enter it. → 0006.0 (min)
(Entire display flashes once.)

Since “not” is displayed for setting out of the permissible setting range, reset this display by pressing [>] key and set it again.

(5) Output Signal Setting in the Case of <failure> (Function code “9”)

Analog output when <failure> occurs in <MEAS.> mode can be fixed to a preset value. (For selecting preset value output, see (9).)

Set the preset value using a span % value in the output range. A range of -10 to 110 % can be set.

The following shows the setting key operation procedure:

(a) Select function code "9". → 00000 %

(b) Press [>] key. → 00000 %
(Leftmost digit flashes.)

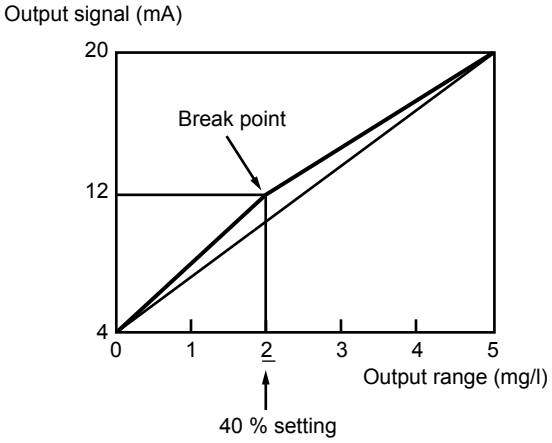
(c) Select the digit using [>] key and set a numeric value using [Λ] and [v] keys. → 00100 %
(Last set digit flashes.)

(d) Press [ENT] key to enter it. → 00100 %
(Entire display once flashes.)

Since “not” is displayed for inputs out of permissible range, reset this display by pressing [>]key and set it again.

(6) Line-Segment Function Output Setting (Function code “A”)

Analog signals can be output in the form of line-segment function. The setpoint value (%) of the function for a span (mg/l) in the output range is the break point corresponding to 50 % of the output signal (4 to 20 mA or 1 to 5 V) span. The setting range is 0 to 100 %. Figure 5.9 shows a setting example.



Example of setting
Output range : 0 to 5 mg/l
Output : 4 to 20 mA
Break point setting : 40 % (2 mg/l)

Figure 5.9 Example of Line-Segment Output

If the setpoint is specified at 50 %, the output becomes linear. Also, if set to 0 % or 100 %, the output is as shown in Figure 5.10.

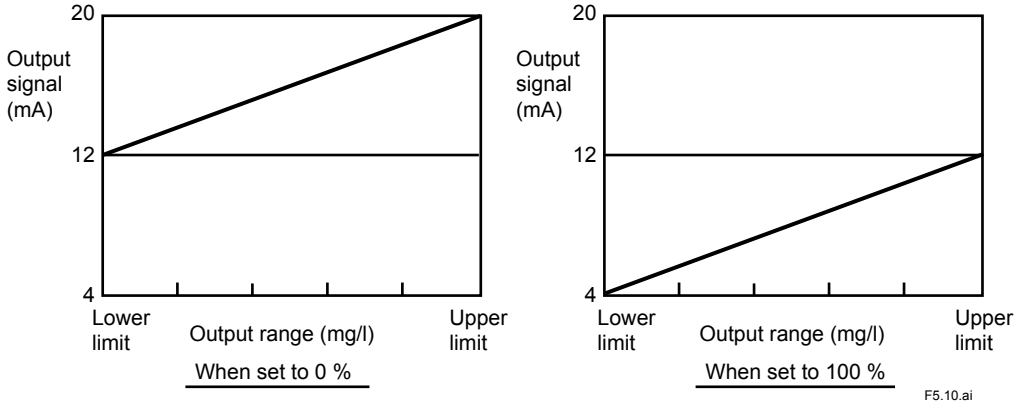


Figure 5.10 Output when break point is set to 0 % or 100 %.

The setting key operation procedure is shown below.

(a) Select function code "A". → 00050 %
(b) Press [>] key. → 00050 %
(Leftmost digit flashes.)
(c) Select the digit using [>] key and set a numeric value using [Λ] and [v] keys. → 00040 %
(Last set digit flashes.)
(d) Press [ENT] key to enter it. → 00040 %
(Entire display once flashes.)

For inputs out of the setting range, “not” is displayed. Reset the display by pressing [>] key and set it again.

(7) Concentration Upper Limit Alarm Setpoint Setting (Function code “b”)

If the “upper limit alarm function execution” is selected with function code “5.” in <PROGRAM.2> mode, when the residual chlorine concentration (indication) exceeds the setpoint, <FAIL> lamp lights and if in <MEAS.> mode, <failure> contact signal is output.

The range that can be set as the upper limit alarm value is 0.00 to 11.00 mg/l.

The setting key operation procedure is as follows:

(a) Select function code "b". → 011.00 mg/l
(b) Press [>] key. → 011.00 mg/l
(Leftmost digit flashes.)
(c) Select the digit using [>] key and set a numeric value using [Λ] and [v] keys. → 001.50 mg/l
(Last set digit flashes.)
(d) Press [ENT] key to enter it. → 001.50 mg/l
(Entire display once flashes.)

For inputs out of the setting range, “not” is displayed. Reset the display by pressing [>] key and set it again.

(8) Out-of-Sample Detection Concentration Setting (Function code “c”)

This concentration has been set at the value of the 0.10 (mg/l) on shipment.

In this case, if it is assumed that the sample residual chlorine concentration in the normal state is below 0.10 mg/l, an approx. three minute out-of-sample detection in a ten-minute cycle is performed and the output signal is held during the detecting operation.

If the operating conditions are relevant to this case, and if difficulty exists for output signal hold, change the setpoint. As the out-of-sample detection concentration, take approximately 50 % of the sample water residual chlorine concentration value.

The key operation procedure for out-of-sample detection concentration setting is shown below.

(a) Select function code "c". → 000.10 mg/l
(b) Select the digit using [>] key and set a numeric value using [Λ] and [v] keys. → 000.05 mg/l
(c) Pressing [ENT] key sets the data. → 000.05 mg/l
(Entire display flashes once.)

For out-of-sample detecting operation, see subsection 6.1.3.

(9) Setting Averaging Coefficient (time constant) (Function code "d")

The converter display and analog output are computed for average by the program. In this setting, the extent of averaging (signal time constant) can be changed. Table 5.19 shows an approximate correspondence between the averaging coefficient and a 90 % response time.

Table 5.19 Averaging Coefficient and 90 % Response Time

Averaging coefficient	Standard for 90 % response time
1	Approx. 13 sec.
5	Approx. 37 sec.
10	Approx. 68 sec.
15	Approx. 101 sec.
20	Approx. 135 sec.

The 90 % response time is about (13 + (the averaging coefficient-1) x 6.35) seconds. This coefficient is set at 1 (about 13 seconds for a 90 % response time) upon shipment from the factory. If the fluctuation of measured readings is large, e.g., due to suspended matter in the measurement object, change the averaging coefficient as necessary.

The following is the procedure for the setting operation.

(Example)

(a) Select function code "d" in the <PROGRAM. 1> mode. → 00001

(b) Select a digit using [>] key and set a numeric value using the [Λ] or [v] key.
→ 00005

(c) Press the [ENT] key to enter the value. → 00005
(Entire display once flashes.)

If the set value is beyond the permissible range, "not" is displayed. Reset the display by pressing [>] key and set it again.

(10) Range Switching (“Remote/Local”) Selection (Function code “1.”, “2.”)

Analog output includes both “output range-1” and “output range-2”. Select which range is to be output by specifying <remote> or <local>.

When <remote> is selected, the range to be output is determined by the contact input status (see Figure 5.11).

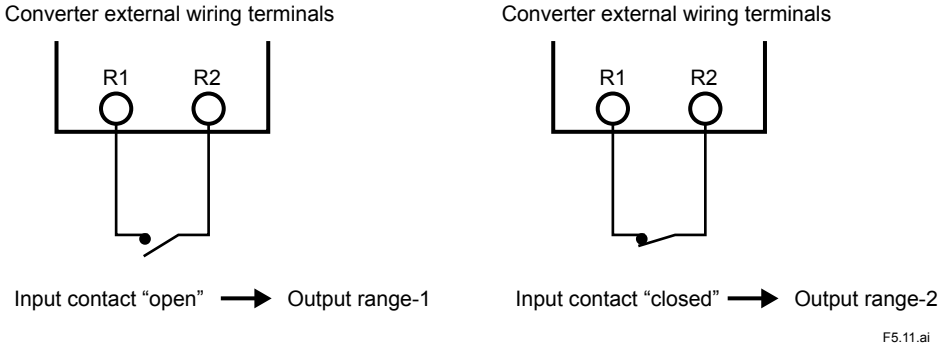


Figure 5.11 Relationship between Contact Input and Output Range in <remote> Range Switching

For <local> selection, select which is to be output “output range-1” or “output range-2” using function code “2.” in the <PROGRAM.1> mode.

- **Remote/Local Selecting Operation**

(a) Select function code "1.". → on (Remote)
oFF (Local)

(b) Every time [>] key is pressed, on and oFF are alternately displayed. → on ↔ oFF

(c) Select on (remote) or oFF(local). → oFF

(d) Press [ENT] key to enter it. → oFF (Flashes once.)

- **Output Range Selection at <local>**

(a) Select function code "2." → _ _ 1 (Range 1)
_ _ 2 (Range 2)

(b) Every time [>] key is pressed, _ _ 1 and _ _ 2 are alternately displayed. → _ _ 1 ↔ _ _ 2

(c) Select _ _ 1 (output range-1) or _ _ 2 (output range-2). → _ _ 2

(d) Press [ENT] key to enter it. → _ _ 2 (Flashes once.)

(11) Output Mode ("Hold/No Hold") Selection in maintenance (Function code "3.")

In maintenance (<MAINT.> mode, <PROGRAM.1> mode, and <PROGRAM.2> mode), analog output signal "hold/no hold" is selected.

The setting key operation procedure is shown below.

(a) Select function code "3.". → on (Hold)
oFF (No hold)

(b) Every time [>] key is pressed, on and oFF are alternately displayed. → on ↔ oFF

(c) Select on (hold) or oFF (no hold). → on

(d) Press [ENT] key to enter it. → on (Flashes once.)

The output mode set here becomes valid immediately after the setting operation.

If "on (hold)" is selected, <HOLD> lamp lights during output hold.

Even if "no hold" is selected in this function, if "hold" or "preset" has been selected in function code "4." in the <PROGRAM.1> mode (Output Signal Mode Selection in <failure>), the latter dominates.

(12) Output Signal Mode Selection in <failure> (Function code "4.")

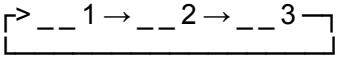
This function can set analog output signal mode when <FAIL> lamp lights as a result of failure occurrence in any of the output modes, hold, no hold, or preset.

The output mode set here is applied when <failure> contact signal is output.

The output mode selection key operation procedure is shown below.

(a) Select function code "4.". → _ _ 1 (Hold)
_ _ 2 (No hold)
_ _ 3 (Preset)

(b) Every time [>] key is pressed, 1, 2, or 3 is repeatedly displayed in this order.



(c) Select _ _ 1 (hold), _ _ 2 (no hold), _ _ 3 (preset) → _ _ 3

(d) Press [ENT] key to enter it. → _ _ 3 (Flashes once.)

When "preset" is selected, the output value set in function code "9" becomes valid.

If "hold" or "preset" is selected in this function, these dominate the output mode set in function code "3."

(13) Selection of Automatic Zero Calibration Function “execution/stop” (Function code “5.”)

Whether automatic zero calibration is performed or not can be selected. The setting procedure is shown below.

(a) Select function code “5.”
(b) Each time [>] key is pressed, on and oFF are alternately displayed.
(c) Select on (execution) or oFF (stop).
(d) Press [ENT] key to enter it.

The automatic zero calibration mode set in this code will be valid soon after the setting.

- When the automatic zero calibration mode is set to “execution,” a zero flushing function, which allows chlorine-free water to pass once every 24 hours under the following conditions, *1 and *2, is enabled (during the zero flushing, the indication is held). This function is provided to prevent corrosion of the activated charcoal filter.

*1: The automatic zero calibration function is enabled.

*2: The automatic zero calibration cycle is longer than one day. (Refer to subsection 7.2.2)

(14) Selection of Cleaning Sequence to be used (Function code “8.”)

One sand filter is used for the RC400G-2 residual chlorine analyzer for raw water, and two sand filters are used for the RC400G-3 residual chlorine analyzer for treated water.

Hence, sand filter cylinder cleaning is performed in different cleaning sequences for the RC400G-2 and for the RC400G-3 (see subsection 5.3.5).

In this function code, the relevant cleaning sequence must be entered for either one cylinder or two cylinders depending on the specifications for the analyzer used. However, since it is already entered on shipment, it is usually unnecessary to specifically conduct it.

If entry is necessary, perform key operation in the following procedure:

(a) Select function code "8.". → _ _ 1 (One cylinder)
_ _ 2 (Two cylinders)
(b) Every time [>] key is pressed, _ _ 1 and _ _ 2 are alternately displayed. → _ _ 1 ↔ _ _ 2
(c) Select _ _ 1 (one cylinder type) or _ _ 2 (two cylinders type). → _ _ 2
(d) Press [ENT] key to enter it. → _ _ 2 (Flashes once.)

When transferred to <MEAS.> mode, a cleaning sequence relevant to the one entered here is activated.

However, if the sand filter cylinder cleaning function is set to “oFF (stop)” with function code “A”, the cleaning sequence is not activated.

(15) Selection of Measuring Tank Cleaning Function “execution/stop” (Function code “9.”)

For the RC400G-2 (raw water) or the RC400G-3 (treated water) residual chlorine analyzer, automatic cleaning of the measuring tank and sand filter cylinder(s) using cleaning water can be executed based on the set sequences.

In this function code, measuring tank cleaning “execution/stop” should be set. For residual chlorine analyzers of the relevant specifications, cleaning execution is set on shipment. Thus, since cleaning is normally executed, it is unnecessary to specifically reset it.

If it is necessary to stop the measuring tank cleaning function, operate keys in the following procedure:

(a) Select function code "9.". → on (Cleaning execution)
→ oFF (Cleaning stop)
(b) Every time [>] key is pressed, on and oFF are alternately displayed. → on ↔ oFF
(c) Select on (execution) or oFF (stop). → oFF
(d) Press [ENT] key to enter it. → oFF (Once flashes.)

(16) Selection of Sand Filter Cylinder Cleaning Function “execution/stop” (Function code “A.”)

In this function code, sand filter cylinder “execution/stop” should be set. If “on (execution)” is selected, sand filter cylinder cleaning is executed through the cleaning sequence selected with function code “8.”.

For residual chlorine analyzers of the relevant specifications, cleaning execution is already set in shipment. Thus, since normally cleaning is executed, it is unnecessary to specifically set it again.

If it is necessary to stop sand filter cylinder cleaning function, operate keys in the following procedure:

(a) Select function code "A.". → on (Cleaning execution)
oFF (Cleaning stop)
(b) Every time [>] key is pressed, on and oFF are alternately displayed. → on ↔ oFF
(c) Select on (execution) or oFF (stop). → oFF
(d) Press [ENT] key to enter it. → oFF (Flashes once.)

(17) Selection of Out-of-sample Detecting Function “execution/stop” (Function code “b.”)

If open status occurs between the electrodes without supply of sample water in the measuring tank, the diffusion current is stable even if the applied voltage is changed.

This analyzer has an out-of-sample detecting function utilizing the above fact (for details, see subsection 6.1.3).

The out-of-sample detecting function operates only in <MEAS.> mode and if out-of-sample is detected, <FAIL> lamp lights and a <failure> contact signal is output.

In this function code, out-of-sample detecting function “execution/stop” should be set.

Out-of-sample detection “execution” is already set on shipment.

If the function is to be stopped, operate keys in the following procedure:

(a) Select function code "b.". → on (Detection execution)
oFF (Detection stop)
(b) Every time [>] key is pressed, on and oFF are alternately displayed. → on ↔ oFF
(c) Select on (execution) or oFF (stop). → oFF
(d) Press [ENT] key to enter it. → oFF (Flashes once.)

(18) Concentration Display Unit Selection (Function code “c.”)

Either “mg/l” or “ppm” can be selected as the unit of residual chlorine concentration displayed in the converter.

On shipment, the specified unit has been set to be displayed.

If this setting is to be changed, operate keys in the following procedure to set the unit again:

(a) Select function code "c.". → _ _1 (mg/l)
_ _ 2 (ppm)

(b) Every time [>] key is pressed, _ _ 1 and _ _ 2 are alternately displayed. → _ _ 1 ↔ _ _2

(c) Select _ _ 1 (mg/l) or _ _ 2 (ppm). → _ _ 2

(d) Press [ENT] key to enter it. → _ _ 2 (Flashes once.)

The selected unit appears to the right of data when a residual chlorine concentration is displayed (see Figure 5.12).

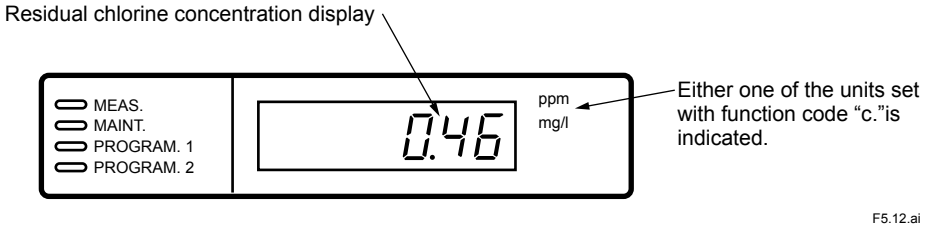


Figure 5.12 Residual Chlorine Concentration Unit Indication

(19) Selection of Air Pump Action Function “execution/stop” (Function code “d.”)

An air pump for air purge is added only when it is specified.

The air pump action function is that which always places the air pump in operating status in <MEAS.> mode.

Hence, if “on (execution)” is set with this function code, the air pump automatically enters the operating status even if the mode is transferred to <MEAS.> mode with the air pump action stopped.

If the air pump is added, it has been set at “on” on shipment.
Thus it is unnecessary to specifically set it.
If it is to be changed to “oFF (stop)”, set it again by the following key operation:

(a) Select function code "d.". → on (Execution)
oFF (Stop)

(b) Every time [>] key is pressed, on and oFF are alternately displayed. → on ↔ oFF

(c) Select on (execution) or oFF (stop). → oFF

(d) Press [ENT] key to enter it. → oFF (Flashes once.)
oFF (Cleaning stop)

(b) Every time [>] key is pressed, on and oFF are alternately displayed. → on ↔ oFF

(c) Select on (execution) or oFF (stop). → oFF

(d) Press [ENT] key to enter it. → oFF (Flashes once.)

(20) Selection of negative (below-zero) display in <MEAS.> mode (Function code “E.”)

When this function is set to on (enabled), a negative value (below 0.00 mg/l) is not displayed even if the measured residual chlorine concentration value is negative. However, this setting can only be enabled in <MEAS.> mode.

The factory setting is disabled. If the setting is to be changed, perform the following key operation.

(a) Select function code “E.”. → on (enabled)
oFF (disabled)

(b) Every time [>] key is pressed, on and oFF are alternately displayed. → on ↔ oFF

(c) Select on (enabled) or oFF (disabled) → on

(d) Press [ENT] key to enter it. → on (Flashes once.)

NOTE

If the value is below -1.00 mg/l, “O.L” is displayed, regardless of the setting.

(21) Selection of below-4-mA output hold in <MEAS.> mode (Function code “F.”)

When the function is set to on (enabled), analog output does not fall below 4 mA but is held at 4 mA. However, this setting can only be enabled in <MEAS.> mode.

The factory setting is disabled. If the setting is to be changed, perform the following key operation.

(a) Select function code “F.”. → on (enabled)
oFF (disabled)

(b) Every time [>] key is pressed, on and oFF are alternately displayed. → on ↔ oFF

(c) Select on (enabled) or oFF (disabled) → on

(d) Press [ENT] key to enter it. → on (Flashes once.)

5.3.5 Key Operation in <PROGRAM.2> Mode

In <PROGRAM.2> mode, each time-setting in cleaning sequences and also “execution/stop” of part of failure detecting functions indicated in Table 5.6 are performed.

Function codes “1” to “F” => Cleaning sequence operation time setting

Function codes “1.” to “F.” => Failure detecting function “execution/stop” selection

This subsection describes key operations to be performed by specifying function codes in <PROGRAM.2> mode and displays associated with the key operations.

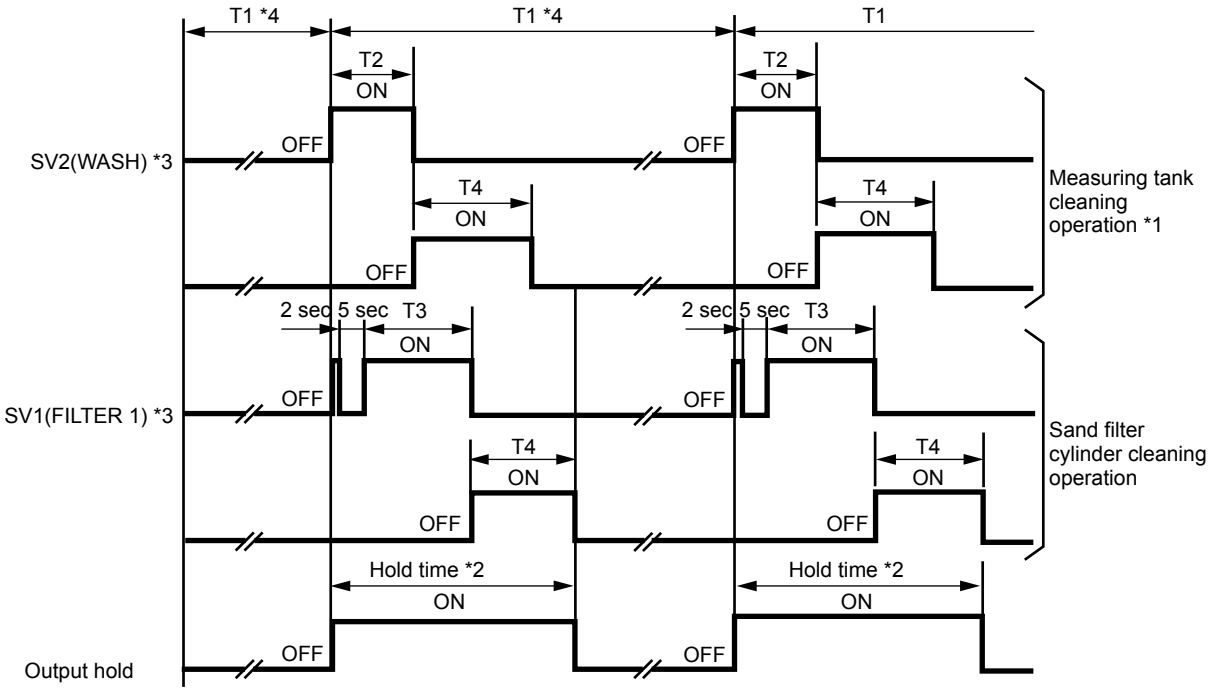
(1) Cleaning sequence and time setting for sand filter “One cylinder type” (Function code “4”, “5”, “6”, and “7”)

(2) Cleaning sequence and time setting for sand filter “Two cylinder type” (Function code “3”, “4”, “5”, “6”, “7”, “8”, and “9”)

(3) Failure detecting function “Execution/Stop” selection (Function code “4.”, “5.”)

(1) Cleaning Sequence and Time Setting for Sand Filter “One Cylinder Type” (Function code “4”, “5”, “6”, and “7”)

Figure 5.13 shows the cleaning sequence for sand filter “one cylinder type” applied to the RC400G-2 residual chlorine analyzers for raw water.



T1: Sand filter cylinder and measuring tank cleaning cycle (residual chlorine concentration measuring time)
T2: Measuring tank cleaning time
T3: Sand filter cylinder cleaning time
T4: Relaxation time

*1: If the measuring tank cleaning function is in stop status. No operation is performed.
*2: The hold time is the following time whichever is longer; (T2 + T4) or (T3 + T4 + 7 sec)
*3: Symbols in ( ) show the relevant external connection terminal names.
*4: This is set function code “6”. This is relevant to sand filter cylinder cleaning cycle (cleaning waiting time). In the T1 period immediately after the mode is switched to the <MEAS.> mode, cleaning operation is not performed. F5.13.ai

Figure 5.13 Cleaning Sequence for Sand Filter “One-Cylinder Type”

The cleaning sequence starts at the instant when the mode is switched to <MEAS.>.

When cleaning is started, the analog output holds at the value immediately before the cleaning start. Hold is reset at the relaxation time completion.
During the analog signal holds, <HOLD> lamp lights.
During cleaning, <WASH> lamp flashes. In response to operations of solenoid valves SV1 and SV2 shown in Figure 5.13, operation display lamps corresponding to each solenoid valve “light/extinguish”.

Table 5.20 shows permissible time setting ranges applied to each cleaning sequence operation shown in Figure 5.13.

Table 5.20 Cleaning Sequence and Time Setting for Sand Filter "One Cylinder Type"

Time Chart Symbol	Function Code	Content	Permissible Setting Range	Setpoint Value on Shipment
T1	6	Sand filter cylinder and measuring tank cleaning cycle	0.1 to 24.0 hours	2.0 hours
T2	4	Measuring tank cleaning time	0.1 to 25.0 min	1.0 min
T3	7	Sand filter cylinder cleaning time	0.1 to 25.0 min	1.0 min
T4	5	Relaxation time after cleaning	0.1 to 25.0 min	5.0 min

If it is necessary to change the setpoint value set on shipment, reset the value in the following procedure:

(Example)

(a) Select function code “4” ("5", "6", "7"). → 0005.0 (min)

(b) Press [>] key. → 0005.0 (min)
(Leftmost digit flashes.)

(c) Select a digit using [>] key and set a numeric value using [Λ] and [v] keys. → 0005.5 (min)
(Last set digit flashes.)

(d) Press [ENT] key to enter the value. → 0005.5 (min)
(Flashes once.)

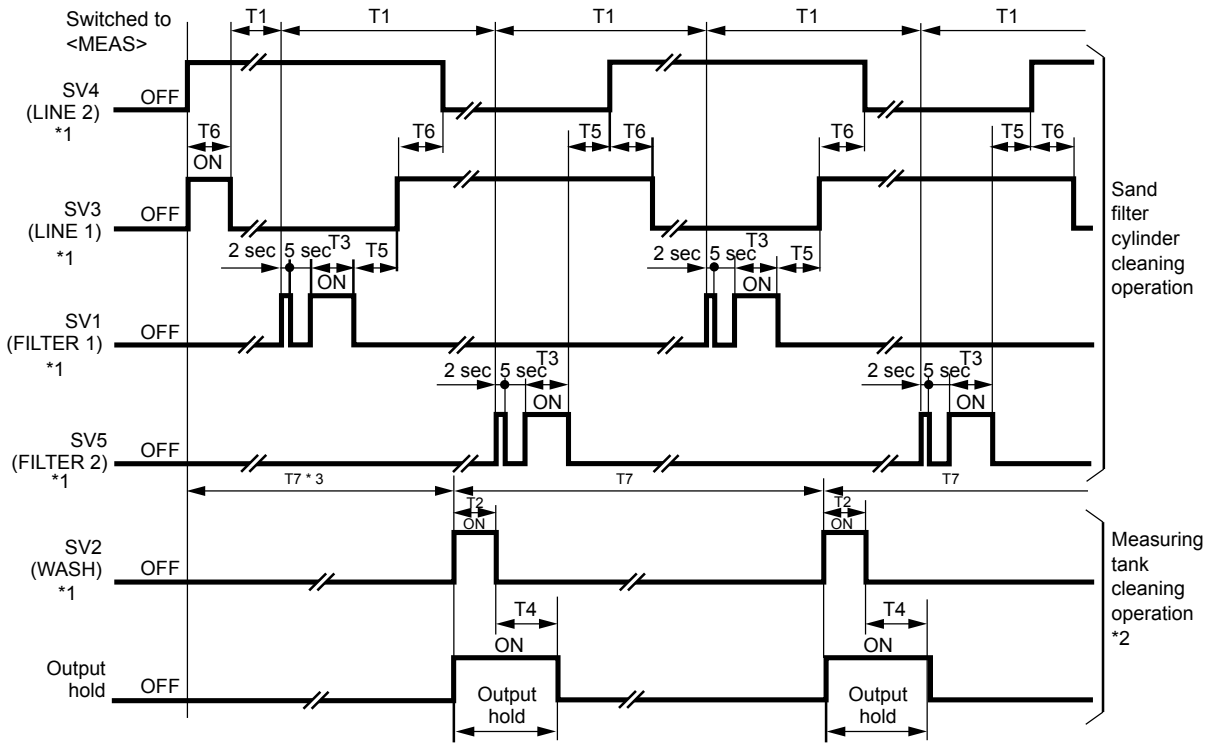
For inputs out of the permissible range, “not” is displayed. Press [>] key to reset this display and reset the time.

NOTE

If the time for automatic zero calibration comes during cleaning, the automatic zero calibration takes precedence over cleaning. The cleaning process is held at the start of automatic zero calibration and the cleaning sequence is not executed. If the time for cleaning comes during automatic zero calibration, the cleaning sequence is not executed.

(2) Cleaning Sequence and Time Setting for Sand Filter “Two Cylinder Type” (Function code “3”, “4”, “5”, “6”, “7”, “8”, and “9”)

Figure 5.14 shows the cleaning sequence for sand filter “two-cylinder type” applied to the RC400G-3 residual chlorine analyzers for treated water.



T1: Sand filter cylinder
T2: Measuring tank cleaning time
T3: Sand filter cylinder cleaning time
T4: Relaxation time
T5: Substitution time
T6: Cross time
T7: Measuring tank cleaning cycle

*1: Symbols in ( ) show the relevant external connection terminal names.
*2: If the measuring tank cleaning function is in stopping status. No operation is performed.
*3: In the T7 period immediately after the mode is switched to the <MEAS.> mode, cleaning operation is not performed.

F5.14.ai

Figure 5.14 Cleaning Sequence Time Chart for Sand Filter "Two-Cylinder Type"

In the sand filter "two-cylinder type" cleaning sequence, the sand filter cylinder cleaning sequence and the measuring tank cleaning sequence operate independently.

A cleaning sequence starts at the time when mode is switched to <MEAS.>. When the measuring tank cleaning starts, the analog output holds at the value immediately before cleaning start. Hold is reset when the relaxation time is completed. During analog output hold, <HOLD> lamp lights.

During cleaning, <WASH> lamp flashes. In response to operations of solenoid valves, operation display lamps corresponding to each solenoid valve "light/extinguish".

Table 5.21 shows permissible time setting ranges applied to each cleaning sequence operation shown in Figure 5.14.

Table 5.21 Cleaning Sequence and TIme Setting for Sand Filter "Two Cylinder Type"

Time Chart Symbol	Function Code	Content	Permissible Setting Range	Setpoint Value on Shipment
T1	6	Sand filter cylinder	0.1 to 24.0 hours	0.5 hours
T2	4	Measuring tank cleaning time	0.1 to 25.0 min	1.0 min
T3	7	Sand filter cylinder cleaning time	0.1 to 25.0 min	1.0 min
T4	5	Relaxation time after cleaning	0.1 to 25.0 min	3.0 min
T5	8	Substitution time *1	0.1 to 25.0 min	6.0 min
T6	9	Cross time *2	0.1 to 25.0 min	1.0 min
T7	3	Measuring tank cleaning cycle	0.1 to 24.0 hours	1.0 hours

*1: Substitution time is the time for stabilizing water in the sand filter
*2: Cross time is the time that overlaps when the sample water line is switched.

If it is necessary to change the value set on shipment, re-set it in the following procedure:

		(Example)
(a)	Select function code “8” ("3" to "7", "9").	→ 0006.0 (min)
(b)	Press [>] key.	→ 0006.0 (min) (Leftmost digit flashes.)
(c)	Select a digit using [>] key and set a numeric value using [Λ] and [v] keys.	→ 0007.0 (min) (Last set digit flashes.)
(d)	Press [ENT] key to enter the value.	→ 0007.0 (min) (Flashes once.)

For inputs out of the permissible range, “not” is displayed. Press [>] key to reset this display and reset the time.

NOTE

If the time for automatic zero calibration comes during cleaning, the automatic zero calibration takes precedence over cleaning. The cleaning process is held at the start of automatic zero calibration and the cleaning sequence is not executed. If the time for cleaning comes during automatic zero calibration, the cleaning sequence is not executed.

(3) Failure Detecting Function “Execution/Stop” Selection (Function code “4.”, “5.”)

For the following two <failure> detection, detection “execution/stop” can be selected:

Table 5.22 Failure Detecting Function Execution/Stop Selection

Function Code	Failure Detecting Function	Permissible Range	Initial Value
4.	Temperature compensation range exceeded	0.0 to 40.0 °C	on *1
5.	Residual chlorine concentration upper limit alarm	Within setpoint *2	on *1

*1: on: Detection execution oFF: Detection stop
*2: Setpoint is set using function code “b” in <PROGRAM.1> mode.

Since this function is set to "on" (detection execution) on shipment, change it in the following procedure, if necessary:

(a)	Select function code “4.” ("5.").	→ on (Detection execution) oFF (Detection stop)
(b)	Every time [>] key is pressed, on and oFF are alternately displayed.	→ on ↔ oFF
(c)	Select on (execution) or oFF (stop).	→ oFF
(d)	Press [ENT] key to enter it.	→ oFF (Flashes once.)

If the function is set to on (execution), <FAIL> lamp lights when a failure is detected and <failure> contact signal is output in <MEAS.> mode.

NOTE

In addition to the above <failure>, “out-of-sample detecting function” “execution/stop” can also be selected. This is specified by function code “b.” in <PROGRAM.1> mode.

6. Converter Operating Functions

Operating functions related to converter operation were partially described in 5. Converter Operation.

This chapter describes details of the already described functions and the other operating functions.

6.1 <failure> Detecting Operation

For types of <failure> detected, see subsection 5.3.3 (8) and others. This section describes detecting operations for major <failure>.

The <failure> status is reset by turning the power off. If abnormal cause is not eliminated after turning the power on, <failure> is detected again and <FAIL> lamp turns on.

6.1.1 Concentration Range Exceeded (Err11)

This is an error which occurs when sample water residual chlorine concentration has exceeded the range of -0.5 to 11.0 mg/l or the current input has exceeded the predetermined range owing to a failure in the measuring circuit system or the like.

Current input check is conducted based on either “Low” or “High” range and it is defines that error occurs when either the range of -7.5 to 37.5 µA or -20 to 70 µA respectively.

Whether “Low” or “High” range is selected is automatically determined by whichever is the large value (mg/l) of two upper limit values in “output range-1” and “output range-2”. If the larger upper limit value is 5.00 mg/l or less, the current input range “Low” is selected, while if it is more than 5.00 mg/l, “High” is selected.

When plateau characteristics are taken, the current input value may exceed the permissible range depending on the applied voltage to be set.

Thus, when plateau characteristics are taken, error code “Err11” failure detecting function is temporarily stopped so that no <failure> is detected.

6.1.2 Sample Temperature Failure (Err12, Err24)

When the sample water temperature exceeds the temperature compensation range (0 to 40 °C) or the temperature input signal value exceeds the permissible range corresponding to that temperature owing to electric circuit system failure, <failure> of error code “Err24” is displayed.

Also, the sample water temperature exceeds the measuring range (0 to 50 °C), <failure> of error code “Err12” is displayed similarly.

The detecting function for “Err24” (temperature compensation range exceeded), “execution/stop” can be selected using function code “4.” in <PROGRAM.2> mode (see subsection 5.3.5).

6.1.3 Out-of-Sample in the Measuring Tank (Err13)

In <MEAS.> mode, when the circuit between electrodes is open owing to decrease of sample level in the measuring tank, <failure> of error code “Err13” (out-of-sample in the measuring tank) is displayed.

However, this detecting function does not operate for about two minutes after power is turned ON. This function also does not operate when “oFF (stop)” is selected using function code “b.” in <PROGRAM.1> mode.

The detection principle of “Err13” uses the fact that residual chlorine concentration indication reads approx. 0 mg/l without sample water in the measuring tank. However, since out-of-sample must be identified from the state when residual chlorine concentration in the measuring tank is close to 0 mg/l, the diffusion current change is also confirmed when the applied voltage is changed.

Figure 6.1 shows the discriminating method between the state either sample is present or not in the measuring tank.

When a measured value of residual chlorine concentration decrease below the predetermined value (set using function code “c” in <PROGRAM.1> mode), the applied voltage changes for a very short time as shown in Figure 6.1. The diffusion current value change owing to this detecting voltage is checked.

When sample is not present in the measuring tank, the diffusion current does not change. When sample is present in the measuring tank and the state between the electrodes is not open, the diffusion current changes presenting plateau characteristics.

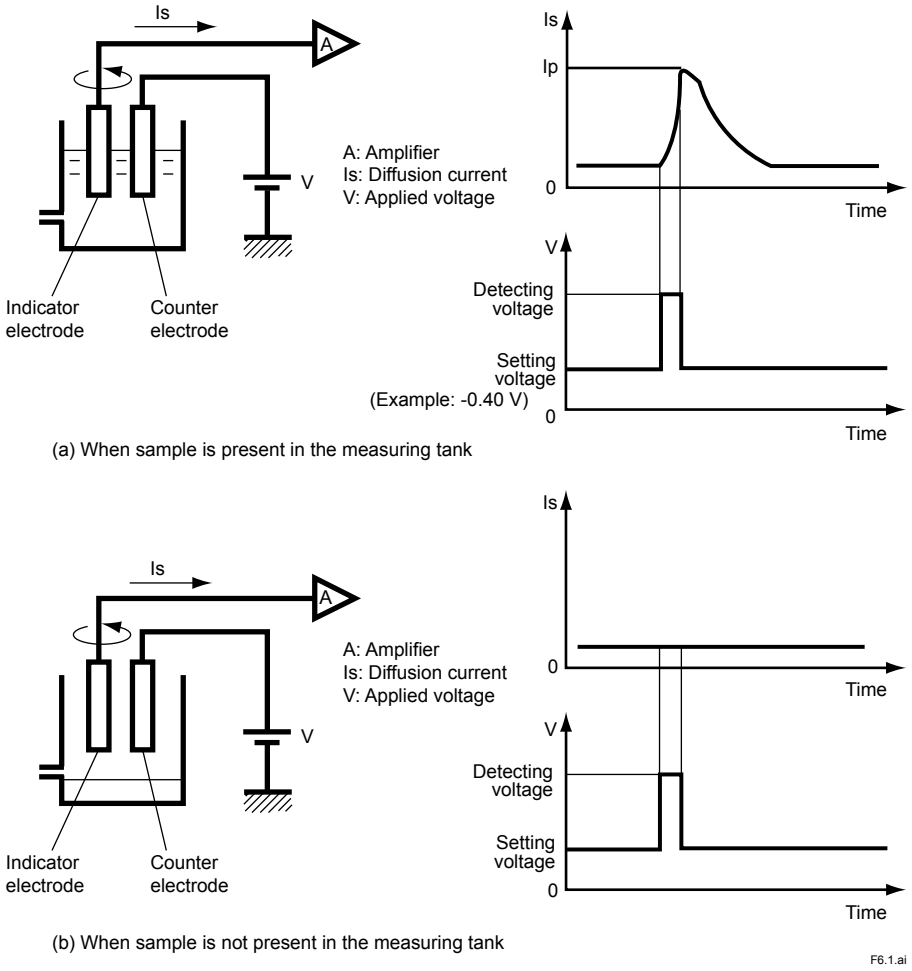


Figure 6.1 Principle of Detecting Out-of -Sample in Measuring Tank

The detecting voltage is applied periodically (approx. 10 min cycle) when the measured concentration value decreases below the predetermined value (set using function code “c” in <PROGRAM.1> mode) in <MEAS.> mode. As shown in Figure 6.2, the reverse voltage is applied after the detecting voltage is applied so that the diffusion current changing time becomes minimum. The detecting operation time in which the detecting and reverse voltages are applied is a few seconds. Including this detecting operation, analog output holds for three minutes after the detecting operation. (Concentration indication changes.)

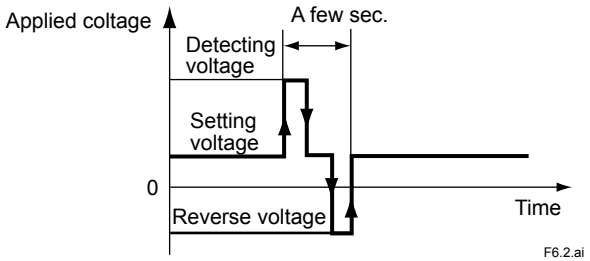


Figure 6.2 Detecting Voltage Waveform

6.1.4 Converter Failure (Err14, Err15, Err16, and Err17)

Converter circuit failure and memory failure are detected in the following method:

(1) AD Circuit Failure (Err14)

By periodically sampling the reference resistance value and reference voltage value in the temperature input circuit, check whether these values are the predetermined ranges or not. If a value exceeds the predetermined range, error code “Err14” <failure> is displayed.

(2) Memory Comparison Failure (Err15)

Each data such as setpoint is stored in two areas in the memory (EEPROM).

During converter operation, each data stored in two areas is periodically mutually compared. If data which does coincide is detected, error code “Err15” <failure> is displayed.

When memory failure is detected, memory contents are initialized in very rare case. In this case, the setting data may be lost.

(3) Memory R/W (Read/Write) Failure (Err16, Err17)

Immediately after converter power is turned ON, the memories that are used (RAM and EEPROM) are checked.

For RAM, by performing the specified data “writing” and “reading”, check if both coincide. When they do not agree, error code “Err16” <failure> is displayed.

For EEPROM, check that the data items stored in two areas coincide. If both do not agree, by performing the specified data “writing” and “reading”, check if both coincide. When they do not agree, error code “Err17” <failure> is displayed.

When these failures are detected, the converter displays error code “Err16” or “Err17” and stops operation (key operation cannot by conducted).

When memory failure is detected, memory contents are initialized in very rare case. In this case, the setting data may be lost.

6.1.5 Concentration Upper Limit Setpoint Exceeded (Err25)

Residual chlorine concentration measured value that exceeds the value set using function code “b” in <PROGRAM.1> mode is handled as failure.

When it is detected that the measured concentration exceeds the setpoint in <MEAS.> mode, error code “Err25” <failure> occurs and a contact signal is output.

This contact output can also be used as an “upper limit alarm”. However, since this contact output is shared by other <failure> contact outputs, fully exercise care for its use as the “upper limit alarm”.

This failure detecting function “execution/stop” can be selected using function code “5.” in <PROGRAM.2” mode.

6.2 Analog Output Signal

Analog output signal is either 4 to 20 mA DC or 1 to 5 V DC corresponding to output range spans. Their selection is performed by changing PCB jumper pin connection in the converter. On shipment, either one that was required by the user has been set.

If change is required, contact Yokogawa because service work is required to be conducted for removing the control panel.

Analog outputs can cover -10 % to 110 % of the span in the output range for bath 4 to 20 mA DC and 1 to 5 V DC (“output range-1” and “output range-2”).

The load resistance is 550 Ω or less for 4 to 20 mA DC output and 300 Ω or less for 1 to 5 V DC output.

6.3 Contact Output

The converter is provided with a function which outputs these types of volt-free contact signal shown in Table 6.1.

Table 6.1 Converter Contact Output Function

Application	Wiring Terminal Names	Contact Status		
		At Power OFF	De-energized	Energized
<failure> contact signal <maintenance> contact signal <Range> contact signal	F1, F2 (FAIL) M1, M2 (MAINT.) SUB OUT	Open Closed Open	Closed Open Open (*)	Open Closed Closed (*)

*1: De-energized status: Range 1, energized status: Range 2

The contact signal <maintenance> in Table 6.1 is output in modes other than <MEAS.> mode.

Table 6.2 shows contact ratings of relays for contact output. Contact loads which satisfy any of these conditions to the wiring terminals.

Table 6.2 Contact Ratings of Relays for COntact Output (Resistive Load)

Item	DC Load	AC Load
Max. permissible power Max. permissible voltage Max. permissible current	60 W 220 V 2 A	125 VA 250 V 2 A

6.4 Contact Input

The converter is provided with a function which receives one type of contact signal input shown in Table 6.3 and executes action in response to the signal requirement.

However, only the contact signal “<remote> range selection” is used for the RC400G residual chlorine analyzers of standard specifications.

Note: For <remote> range selection action, see subsection 5.3.4 (10).

Table 6.3 Converter Contact Input Function

Application	Connection Terminal Names	Contact Input Judgment	
		OFF	ON
Range selection <remote>	RANGE	Input resistance 100 kΩ or more	Input resistance 200 Ω or less

6.5 Default Status When Mode Change

Table 6.4 shows default status of cell motor, metering pumps, and solenoid valves (SV1 to SV6) when mode change.

Table 6.4 Default Status of Pumps, Solenoid Valves, etc. When Mode Change

Equipment Name/ Symbol	<MEAS.> Mode		<MAINT.> Mode		<PROGRAM.1> Mode	<PROGRAM.2> Mode
	RC400G-1, 2	RC400G-3	RC400G-1, 2	RC400G-3		
Cell motor	ON	ON	ON	ON	*2	*2
Metering pump	ON	ON	ON	ON		
Air pump *1	ON/OFF	ON/OFF	ON/OFF	ON/OFF		
SV1 (FILTER 1)	OFF	OFF	OFF	OFF		
SV2 (WASH)	OFF	OFF	OFF	OFF		
SV3 (LINE 1)	OFF	ON	OFF	ON		
SV4 (LINE 2)	OFF	ON	OFF	OFF		
SV5 (FILTER 2)	OFF	OFF	OFF	OFF		
SV6 (SAMPLE/ZERO)	OFF	OFF	OFF	OFF		

*1: The air pump is turned OFF only when "oFF" is selected with function code "d." in <PROGRAM.1> mode.
*2: In <PROGRAM.1> and <PROGRAM.2> modes, the setting data is kept in last mode before mode change.

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7. Calibration

Calibration should be implemented at startup or when analyzer operation is restarted after prolonged operation suspension, and also periodically during operation (nearly once a month).

This chapter describes "running-in" operation conducted when calibration is to be executed and the calibration procedure.

7.1 Running-in Operation

Conduct "running-in" operation in principle when calibration is to be implemented. Conduct "running-in" operation without fail when calibration is to be performed at analyzer startup or after prolonged analyzer operation suspension, or for calibration when values displayed with function code "8" or "9" in <MEAS.> mode greatly deviate from the reference values.

Start "running-in" operation at polishing of the indicator electrode. For the polishing procedure, conform to subsection 4.3.10.

After mounting the polished indicator electrode, press [CELL] key and rotate the electrode. Leave the analyzer to operate in <MAINT.> mode.

Calibration should be performed after continuing this "running-in" operation for about 30 min.

When new sand is used in the sand filters of the RC400G-2 or RC400G-3 residual chlorine analyzer, chlorine in the sample water may be absorbed by the sand, resulting in measurement errors. Upon startup or after sand is replaced, allow water to run for 2 to 3 hours, and perform calibration after the reading has stabilized. Furthermore, allow water to run for about one day for complete stabilization of sand, and then perform calibration again.

7.2 Zero Calibration

Calibration methods for residual chlorine analyzer zero point include the "open input circuit method" and "chlorine-free water method".

The "open input circuit method" is a calibration method which is conducted with no current flowing between the indicator electrode (rotating gold alloy electrode) and the counter electrode exposing the electrodes in the air. The "chlorine-free water method" is a calibration method which is conducted using water that does not contain chlorine.

In general, perform zero calibration using the simple open input circuit method. However, when trace residual chlorine (0.1 ppm) is to be usually measured, conduct the zero calibration using the chlorine-free water method.

7.2.1 Zero Calibration Using Open Input Circuit Method

Perform zero calibration using the open input circuit method in the following procedure:

(1) Press [CELL] key in <MAINT.> mode to stop turning of the indicator electrode. When the electrode rotation is in stopping status, <CELL> lamp extinguishes.

Next, the electrode mechanism block is removed from the measuring tank (see Figure 4.7).

(2) Set the function code to "1". The content of this code is "zero calibration".

(3) Start calibrating operation. Press [ENT] key.

During calibrating operation, <CAL> lamp flashes. Calibration is performed when the analyzer stabilizes so that predetermined conditions (see subsection 5.3.4 (4)) are met after measured value stability is automatically checked.

When calibration is executed, the value displayed in the data display flashes once and, at the same time, flashing <CAL> lamp extinguishes.

(4) Re-mount the electrode mechanism block to the measuring tank.

Also, press [CELL] key to rotate the indicator electrode.

7.2.2 Zero Calibration Using Chlorine-Free Water

Conduct zero calibration using the chlorine-free water in the following procedure: Mount the electrode mechanism block to the measuring tank and turn the indicator electrode in advance.

(1) Prepare chlorine-free water of approx. 2 to 3 liter produced by passing sample water through activated charcoal filter in a suitable vessel.

Also prepare a tube (O.D. 6 mm x I.D. 4 mm) for supplying this chlorine-water to the residual chlorine analyzer.

(2) Set the vessel containing chlorine-free water so that the water level satisfies the conditions shown in Figure 7.1.

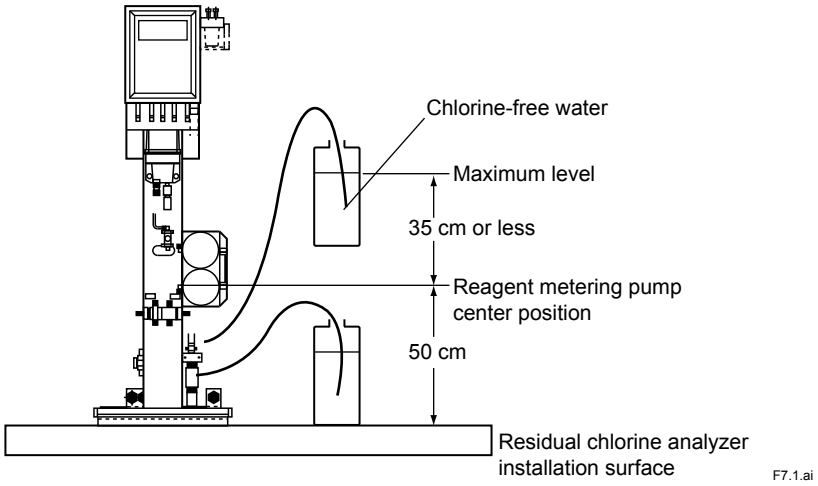


Figure 7.1 Chlorine-Free Water Level

(3) Connect one end of the tube for supplying chlorine-free water to the residual chlorine analyzer standard solution tubing connecting port (Rc1/4 screw). Immerse the opposite end of the tube in chlorine-free water.

(4) Transfer the “sample water/standard solution” selector valve to the “standard solution” position and feed the detector with chlorine-free water.

The measured value normally stabilizes in approx. 5 to 10 min.

(5) Confirm that the mode is <MAINT.> and set the function code to “1”.

The content of this code is “zero calibration”.

(6) Start calibrating operation. Press [ENT] key.

During calibrating operation, <CAL> lamp flashes. Calibration is performed when the analyzer stabilizes to that predetermined conditions are met after measured value stability is automatically checked.

When calibration is executed, the value displayed in the data display flashes once and, at the same time, flashing <CAL> lamp extinguishes.

After calibration, pass chlorine-free water for short period of time and confirm that indication holds the value of 0 ppm stably.

(7) Now the zero calibration is completed.

Leave the tube for supplying chlorine-free water as connected and subsequently conduct span calibration.

7.2.3 Automatic Zero Calibration Using Chlorine-Free Water

Automatic zero calibration is performed using an activated charcoal filter. The parameters should be set in following the procedure.

(1) Select “execution (on)” in function code “5.”, “Automatic zero calibration function” in <PROGRAM.1>. The default setting is “stop (oFF).”

(2) Set the automatic zero calibration sequence parameters in “A,” “b” and “c” in <PROGRAM.2>. Function code “A” is “Setting automatic zero calibration cycle,” function code “b” is “Setting automatic zero calibration preparation time” and function code “c” is “Setting automatic zero calibration relaxation time.” The default settings are: “10 days (note: refer to zero filter flushing function)” for function code “A”, “10 minutes” for function code “b” and “10 minutes” for function code “c”.

Once automatic zero calibration starts, the analog output is held, <HOLD> lamp turns on, and <CAL> lamp flashes. At the same time, the solenoid valve SV6 is energized to let chlorine-free water flow and the analyzer waits a preset calibration preparation time. When the analyzer reads a value approximate to zero and confirms that the reading has stabilized, it performs zero calibration. The analyzer checks the stability using the same criteria of manual calibration. After the calibration is completed, the solenoid valve SV6 is de-energized to let sample water flow and the analyzer waits a preset relaxation time, the time required for zero water to be replaced with sample water. The held analog output is released, and <HOLD> and <CAL> lamps turn off.

NOTE

1) The automatic calibration will be aborted if the mode is changed to the one other than the <MEAS.> mode during the calibration. Upon abort, the held analog output is released, and <HOLD> and <CAL> lamps turn off. The calibration cycle timer is reset.

2) The [FUNC] key is valid even during automatic calibration. ([FUNC] key does not affect the automatic zero calibration sequence.)

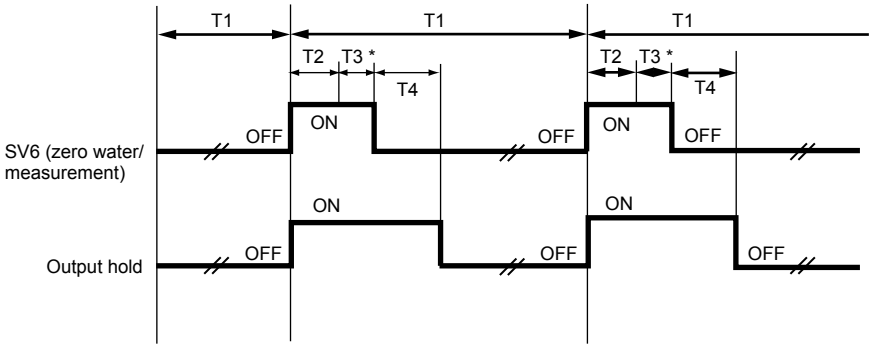
3) The calibration cycle timer will start at zero when:

- the automatic zero calibration is set to “on” upon startup;
- the setting of automatic zero calibration is changed to “on”;
- the automatic calibration cycle is changed (only when automatic zero calibration is enabled).

4) The timer continues to count regardless of operation mode.

5) Automatic zero calibration is executed only when the analyzer is in <MEAS.> mode. If the time for automatic zero calibration comes while the analyzer is in other modes, the calibration will be cancelled. The internal timer is reset and then starts counting.

6) If the time for automatic cleaning comes during automatic zero calibration, the automatic cleaning will be cancelled. If the time for automatic zero calibration comes during automatic cleaning, the automatic cleaning is aborted and the automatic zero calibration starts. In this case, the sequence for switching the solenoid valves SV3 and SV4 continues, but this does not affect the automatic zero calibration.



T1: Automatic zero calibration cycle
T2: Automatic zero calibration preparation time
T3: Zero calibration time
T4: Automatic zero calibration relaxation time

* Zero calibration time may vary depending on calibration condition.
(Maximum time = limit value of response time)

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Figure 7.2 Automatic Zero Calibration Sequence

Zero Filter Flushing Function

This function is activated to prevent corrosion of the activated charcoal filter and is enabled when the following conditions are met.

1) Automatic zero calibration is set to “on.”
2) Automatic calibration cycle is longer than one day.

Flushing Cycle and Sequence

The flushing is activated once every 24 hours and this cycle is fixed. When the flushing is activated, the analog output is held and the <HOLD> lamp turns on. Chlorine-free water is supplied for the preparation time of automatic zero calibration and sample water is supplied for the relaxation time of automatic zero calibration. After the flushing is completed, the held analog output is released and the <HOLD> lamp turns off.

The timer of zero filter flushing cycle is activated or deactivated in the following condition.

The timer is activated when:

- the power is turned on, provided that the analyzer is preset so that it meets the conditions that enable the zero filter flushing function.
- the automatic calibration function is set to “on,” provided that the automatic zero calibration cycle is preset to one longer than one day.
- the automatic zero calibration cycle is changed to the one longer than one day, provided that the automatic calibration function is preset to “on.”

* When the timer is activated, the counter is reset.

The timer is deactivated when:

- the automatic calibration function is changed to “oFF” while the zero filter flushing timer is running.
- the automatic zero calibration cycle is changed to one day or shorter while the zero filter flushing timer is running.

NOTE

1) Zero filter flushing will be aborted if the mode is changed to the one other than the <MEAS.> mode during the flushing. Upon abort, the held analog output is released, and <HOLD> lamp turns off. Also, the zero filter flushing cycle timer is reset.
2) If the [FUNC] key is pressed during zero filter flushing, the zero filter flushing will continue. The selected item remains displayed.
3) If an automatic zero calibration starts during zero filter flushing, the zero filter flushing will be aborted.
4) If the time for zero filter flushing comes during automatic zero calibration, the zero filter flushing will not be executed.
5) If the time for automatic cleaning comes during zero filter flushing, the zero filter flushing will continue and the automatic cleaning will not be executed.
6) If the time for zero filter flushing comes during automatic cleaning, the automatic cleaning will be aborted and the zero filter flushing will be executed.
7) Zero filter flushing is executed only when the analyzer is in <MEAS.> mode. If the time for zero filter flushing comes when the analyzer is in the other modes, the zero filter flushing will not be executed. The timer is reset and then starts counting.

7.3 Span Calibration

NOTE

Before performing a span calibration, make sure that the electrode mechanism block is properly installed in the measuring tank after the zero calibration and also that the electrode rotates smoothly in the cell.

Conduct span calibration using a calibrating standard solution which has a residual chlorine concentration of around 80 % of the output range used.

Dilute commercially available sodium hypochlorite (NaClO) using purified water and adjust it so that a residual chlorine concentration of around 80 % of the output range can be obtained.

A calibrating standard solution of approx. 2 to 3 liter is required.

Conduct span calibration in the following procedure:

(1) Provide the prepared calibrating standard solution of 2 to 3 liter in a suitable vessel.

(2) Feed the residual chlorine analyzer with the calibrating standard solution.

Set the vessel containing the calibrating standard solution in accordance with Figure 7.1. Immerse the opposite end of the tube connected to the standard solution tubing connecting port in zero calibration in the calibrating standard solution. Now the calibrating standard solution can be fed to the detector (ensure that the “sample water/standard solution” selector valve is turned to the “standard solution” position).

The measured value displayed in the data display normally stabilizes in approx. 5 to 10 min.

(3) After the displayed measured value has almost stabilized, confirm that the mode is <MAINT.> and then set function code to “2”.

This code content is “span calibration”.

(4) Set the residual chlorine concentration value of the calibrating standard solution.

First, measure residual chlorine concentration of the calibrating standard solution by manual analysis. In principle, perform measurement using amperometric titration (AT method).

Note: Yokogawa employs amperometric titration for calibration.
On pressing [>] key, the most significant digit of the displayed value flashes indicating that input is possible. Select the digits whose numeric values are to be changed using [>] key and change the values using [Λ] and [v] keys.

(5) After equalizing the displayed value to the residual chlorine concentration of the calibrating standard solution, execute span calibration.

Press [ENT] key. During the calibrating operation, <CAL> lamp flashes. Calibration is performed when the analyzer stabilizes so that predetermined conditions are met after measured value stability is automatically checked.

When calibration is executes, the value displayed in the data display flashes once and, at the same time, flashing <CAL> lamp extinguishes.

(6) Now the span calibration is completed.

Remove the tube used for calibration and transfer the “sample water/standard solution” selector valve to the “sample water” position.

If error message “Err22” <failure> is detected in span calibration, this calibrating operation becomes invalid. Recalibrate span exercising care for correct entry of calibration standard solution residual chlorine concentration.

“Err22” is detected when the ratio of measured sensitivity to the reference sensitivity is less than 0.5. The reference sensitivity set on shipment is the value of “2.62 μA/mg/l at 20 °C” based on amperometric titration.

When the standard solution residual chlorine concentration is measured using manual analysis other than amperometric titration (colorimetry, iodometric titration, etc.), if span calibration cannot be executed by more accurate measurement, change the reference sensitivity to meet the manual analytical method employed.

Reference sensitivity changing method is two-fold: predetermined reference sensitivity manual entry and automatic change by span calibrating operation.

For reference sensitivity manual entry, specify function code “4” in <PROGRAM.1> mode. Perform key operation for entry referring to subsection 5.3.4 (2).

For automatic change, perform span calibration with function code “d” in <MAINT.> mode. (See subsection 5.3.3 (3).)

8. Maintenance

This chapter describes inspection and maintenance implemented for good operating conditions. For measures when failure occurs in operations and others, see Chapter 9.

8.1 Inspection/Maintenance Items and Intervals

Main inspection and maintenance items and recommended intervals to keep the analyzer in good operating condition, are shown. Tables 8.1 and 8.2 show recommended intervals for inspection and maintenance of limited life components. Recommended intervals shown in Table 8.1 is set from the preventive point of view and there is no guarantee against failure. The inspection and maintenance intervals should be determined in accordance with individual operating conditions.

Table 8.1 Inspection/Maintenance Items and Intervals

Inspection/Maintenance Item	Recommended Intervals
Reagent replenishment	As needed
Indicator electrode polishing	Monthly
Indicator electrode replacement	Yearly
Glass beads cleaning	3 months
Glass beads replacement	Yearly
Calibration	Monthly
Metering pump driving section oiling	Monthly
Replacement of Bellofram and valve sheet in metering pump	6 months
Metering pump delivery flow rate confirmation	When Bellofram is replaced
Sand inspection	Occasionally
Electrode mechanism block inspection:	See subsection 8.10
Brush and slip ring	
Drive belt	
Driven shaft assembly	
Motor assembly/gear head	
Activated charcoal filter	Yearly

8.2 Reagent Replenishment

Reagents are consumed at the rate of 2 to 2.4 l/day. When there is but slight reagent left in the reagent tank, replenish with reagent prepared in advance with subsection 4.2.1.

Normally replenish reagent by transferring the reagent prepared in a different tank to the reagent tank. If reagent is to be prepared directly in the reagent tank, and purified water as accurately as possible considering the remaining reagent volume.

When preparing reagent, do not neglect to stop the metering pump by pressing [PUMP] key on the control panel.

8.3 Indicator Electrode Polishing

Since the indicator electrode rotates at a constant speed or 600 rpm (at 50 Hz), its gold alloy surface is constantly and automatically polished by the glass beads. However, although the polishing effect is significant, contamination adhesion is not completely prevented, and contamination gradually increases with time lapse.
Contamination of the gold alloy surface causes a meaning error which increases corresponding to the amount of contamination increase. Thus, it is necessary to remove contamination by polishing the gold alloy surface with polishing agent (alumina) before this measuring error exceeds the permissible value.
Polishing frequency varies with sample water quality, and could extend to possibly once every several months. In principle, it is recommended that polishing be implemented once a month.
For the polishing procedure, refer to subsection 4.3.10. Also, perform calibration after polishing completion.

8.4 Glass Beads and Measuring Tank Cleaning

If the glass beads are contaminated, polishing effect is reduced and the indicator electrode is likely to be contaminated.

Periodically clean the glass beads. At the same time, clean the measuring tank.

Conduct cleaning in the following procedure:

(1) Press [CELL] key in <MAINT.> mode to stop indicator electrode revolution.

When electrode rotation stops, <CELL> lamp extinguishes.

(2) Remove the electrode mechanism block.

Loosen two screws fixing the electrode mechanism block to the measuring tank bracket and raise the electrode mechanism block.

(3) Remove the bead case, with glass beads contained, together with the beads case cover from the measuring tank. Since the beads case cover is fit rather tight, take care not to break it.

(4) Clean the measuring tank.

Remove contamination adhering to the measuring tank using a brush dipped in neutral detergent. If manganese or iron adheres, clean the cell using diluted hydrochloric acid.

Finally, clean out the detergent using water.

NOTE

Do not use organic solvents for cleaning the measuring tank. Otherwise, the transparency may be damaged or cracks may occur.

(5) Transfer the glass beads to another container and wash the dirt off with dilute hydrochloric acid. Then, rinse well with water.

(6) Clean the bead case and beads case cover.

Clean them according to the procedure described in step (4), cleaning the measuring tank.

NOTE

The beads case cover may become clouded in long-term use, which provides no harm in use.

(7) Install the bead case in the beads case cover and put the cleaned glass beads into the bead case.
If the beads have obviously become smaller in size (much smaller than a diameter of 1.7 to 2.3 mm), replace them with new ones.

NOTE

Glass beads are worn in long-term use, thereby reducing the ability of polishing indicator electrode.
The glass beads should be entirely replaced once every year.
For optimum polishing, the glass beads should be placed in the bead case so that the height of bead bed reaches the lowest slit position with the indicator electrode inserted. (The polishing ability cannot be recovered by replenishing the beads only by volume reduced by wear.)

(8) Reinstall the electrode mechanism block and fix it to the bracket using two screws.

(9) Turn on the power switch to restart operation.

8.5 Calibration

It is recommended that calibration be conducted every month. When the indicator electrode has been polished or operation is restarted after being stopped for a long period of time, calibrate zero point and span in the procedure described in Chapter 7.

8.6 Metering Pump Driving Section Oiling

Oil only the lever support block bearing parts shown in Figure 8.1.

Apply two or three drops of the attached lubricant (engine oil) into each block oiling port.

Perform oiling at the approximate rate of once a month.

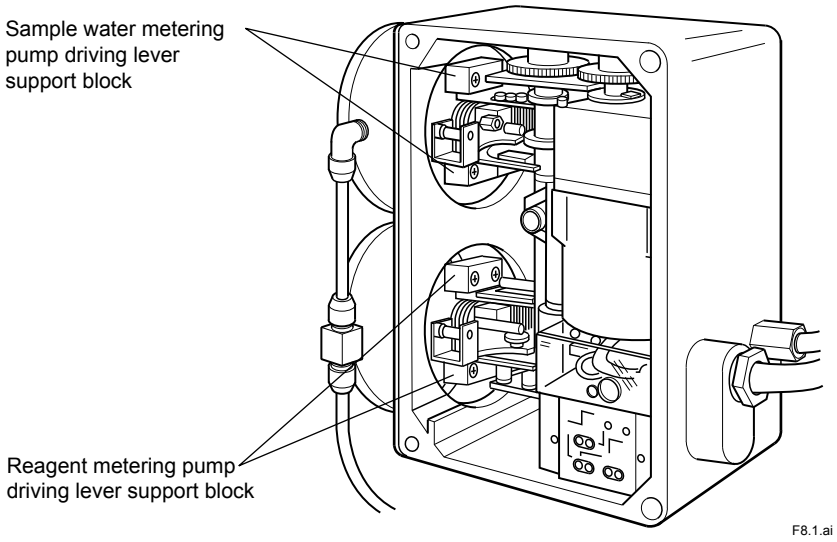


Figure 8.1 Metering Pump Driving Section

8.7 Replacement of “Bellofram” and Valve Sheet in Metering Pump

In principle, replace the metering pump “Bellofram” and valve sheet with new ones, at the rate of once every six months, even if no failure is recognized.

Figure 8.2 shows metering pump construction.

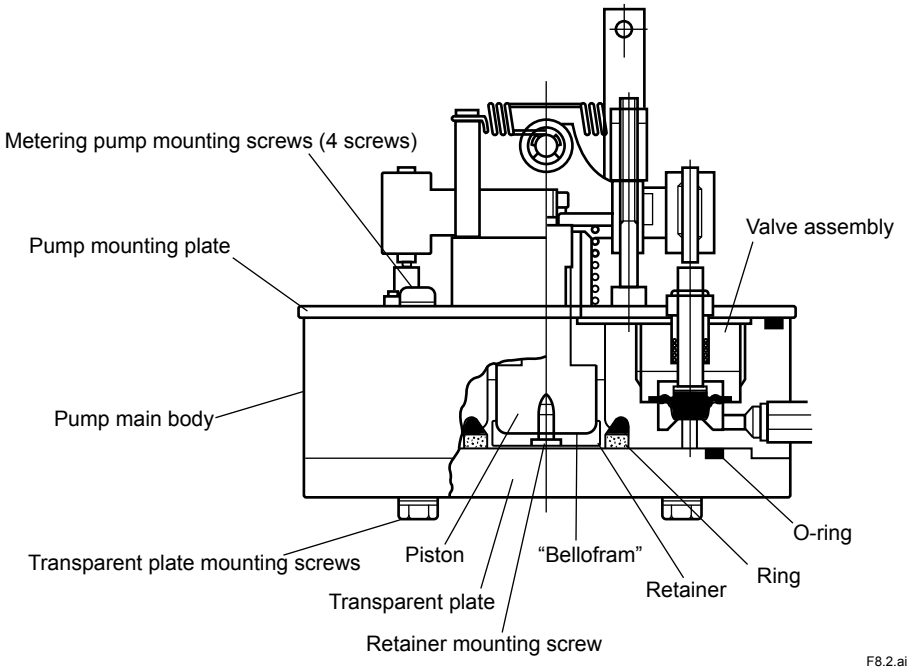


Figure 8.2 Metering Pump Construction

8.7.1 "Bellofram" Replacement

Perform "Bellofram" replacement work using the following procedure:

(1) Press [PUMP] key to stop metering pump operation. Take measures to prevent reagent from flowing out of the reagent tank.

(2) Remove the transparent plate of the metering pump.

Loosen four screws located on the front face.

(3) Remove the ring which forces the "Bellofram" flange down.

(4) Remove the retainer fixed to the piston with screw.

(5) Remove the "Bellofram" which has been used and mount a new "Bellofram".

For mounting, first press the "Bellofram" flange using the ring. Fold the "Bellofram" so as to cover the piston using the attached jig (see Figure 8.3).

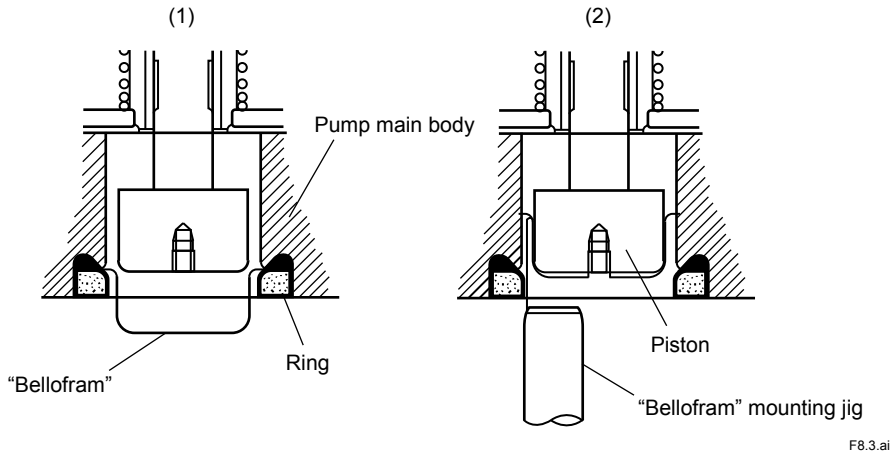


Figure 8.3 "Bellofram" Mounting Procedure

(6) Reassemble the disassembled parts.

8.7.2 Valve Sheet Replacement

Perform replacement work in the following procedure:

(1) Remove the metering pump with the mounting plate.

First, press [PUMP] key to stop metering pump operation.

Next, disconnect the tubing connected to the sample water metering pump delivery joint and the tubing connected to the reagent metering pump suction and delivery joints. Loosen six screws fixing the plate.

When disconnecting tubing, take measures to prevent reagent from flowing out of the reagent tank.

(2) Remove the metering pump from the plate.

First remove the “Bellofram” in according with subsection 8.7.1. Next disconnect the tubings connected to the pump and then loosen four screws located at the rear of the plate.

(3) Remove the valve assembly.

Turn the valve assembly counterclockwise. (It is crowed into the pump main body using a special tool (accessory)).

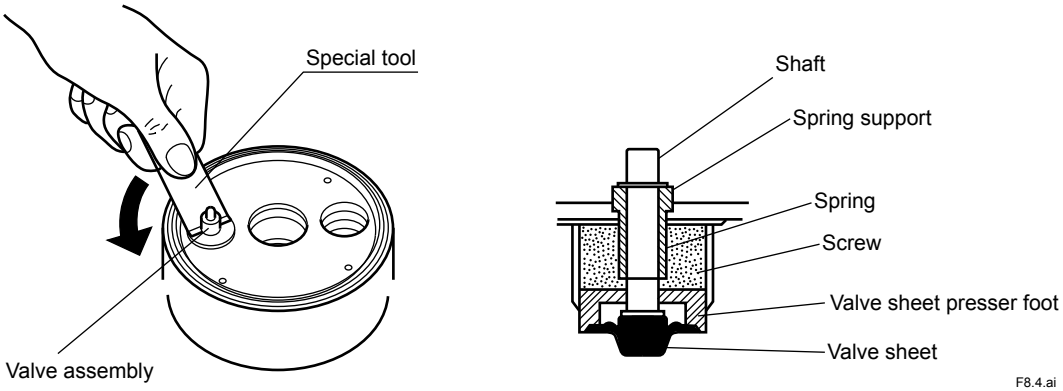


Figure 8.4 Valve Sheet Construction and How to Remove It

(4) Remove the used valve sheet from the shaft and properly fit a new valve sheet to the shaft. Mount the valve sheet so that its flange is not forced out from the valve sheet pressing foot groove.

(5) Fully screw the valve assembly into the pump main body.

(6) Incorporate the metering pump to the pump mounting plate and then mount this plate to the case. When installing, confirm that the drain hole of the metering pump is underneath.

(7) Remount the metering pump parts such as “Bellofram” removed in step (2).

(8) Reconnect once disconnected tubings as before.

(9) Cause reagent to flow out of the reagent tank. Press [PUMP] key to actuate the metering pump and confirm that pump operation is normal.

8.8 Metering Pump Delivery Flow Rate Confirmation and Adjustment

When the “Bellofram” or the valve sheet is replaced, confirm the metering pump delivery flow rate in principle. Confirm the flow rate according to the procedure described in subsection 4.3.5 and 4.3.6. If the flow rate is outside the specified range, adjust the flow rate by changing the position of the stopper located in the pump driving assembly.

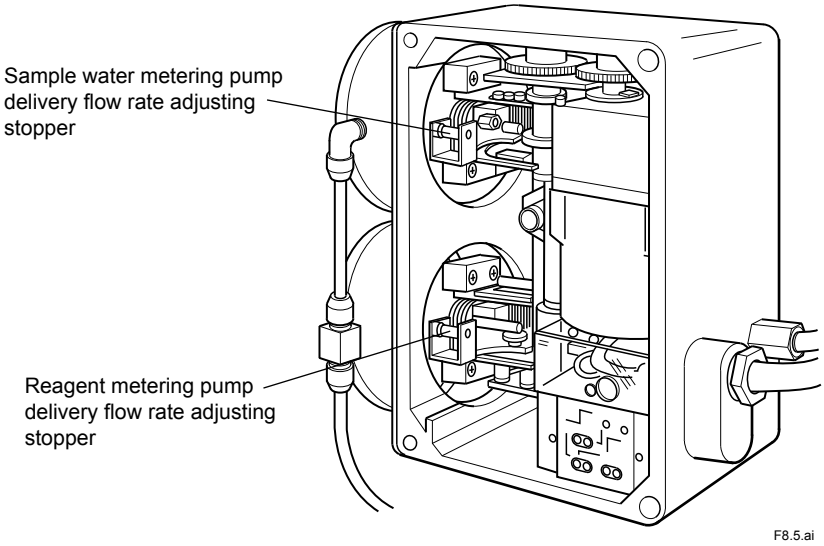


Figure 8.5 Delivery Flow Rate Adjusting Stopper

(1) Press [PUMP] key to stop the metering pump operation.

(2) Shift the relevant stopper.

Loosen the lock nut and turn the stopper clockwise when flow rate is to be decreased and counterclockwise when flow rate is to be increased.

(3) Confirm the delivery flow rate and if it is not yet in the predetermined range, repeat the operation in step (2).

(4) When the flow rate in the predetermined range is obtained, confirm that the lock nut is fully tightened and then restart operation.

8.9 Inspection and Maintenance of Sand Filters

The inspection and maintenance of sand filters are required when the RC400G-2 or RC400G-3 residual chlorine analyzer is used. Follow the procedures below.

8.9.1 Inspection of Sand Filter Surface

Check the surface of sand filter for the formation of mud balls. Formed mud balls should be crushed using a stick. Check that crushed flocks flows out at the time of back washing. To prevent recurrence, the cleaning time should be set longer or the cleaning cycle shorter.

8.9.2 Checking the Sand Volume in Sand Filters

Flocks and other sediment in the sand filters are discharged from the filters by water jet cleaning that is automatically performed at regular intervals.

Improper cleaning intervals may cause formation of thick layer of flocks. In back washing entire sand is lifted by cleaning water and sand is discharged together with flocks, thereby reducing the volume of sand in the sand filters. When the sand is reduced, inconvenience in measurement may result: delayed response because the filtrate rate is reduced by floc layers, larger measurement errors because chlorine is absorbed into the flocks, etc. If the sand is reduced, remove the top cover of the filtration cylinder and replenish the cylinder with sand to scale marking <10> in the cylinder (see Figure 8.6).

8.9.3 Checking the Discoloration of Sand in Sand Filters

Manganese or iron contained in sample water may cause contamination in the measuring tank of the residual chlorine analyzer. Most of them, however, are absorbed by the sand. If the sand has absorbed manganese or iron to such an extent that the entire sand is discolored, replace it with new sand by following the procedure below.

- **Sand Replacement Procedure (see Figure 8.6)**

(1) Close the sample water valve(s) and cleaning water valve to stop supplying sample water and cleaning water.

RC400G-2: Sample water valve V3, cleaning water valve V4

RC400G-3: Sample water valves V3 and V4, cleaning water valve V6

(2) Remove the top cover on the sand filter and remove the sand from the sand filter by hand or using a container. It is not necessarily to remove the sand completely.

(3) If the inner wall of the filter cylinder has been stained (turned black by manganese or umber by iron), clean it with dilute hydrochloric acid or appropriate cleaner.

(4) Replenish the filter cylinder with new sand to scale marking <10>.

(5) Reinstall the top cover on the sand filter, open the sample water valve(s) and cleaning water valve to start supplying sample water and cleaning water.

8.9.4 Filter Replacement

A filter is installed at the bottom of the sand filter to prevent the sand from falling off (see Figure 8.6). When the filter is clogged and the specified flow rate cannot be achieved, replace the filter by following the procedure below.

- **Filter Replacement Procedure (see Figure 8.6)**

(1) Close the sample water valve(s) and cleaning water valve to stop supplying sample water and cleaning water.

RC400G-2: Sample water valve V3, cleaning water valve V4

RC400G-3: Sample water valves V3 and V4, cleaning water valve V6

(2) Remove the top cover on the sand filter and remove as much sand as possible from the sand filter by hand or using a container.

(3) Loosen the 4 fixing screws at the bottom of the sand filter and remove the sand filter.

(4) Loosen the 4 set screws at the bottom of the filter cylinder and remove the filter by pulling the part of cleaning (tap) water inlet downward. Remaining sand in the filter cylinder, if any, falls together with the filter.

(5) Replace the filter with a new one, reinstall the part of cleaning water inlet, and fix the filter with the set screws. Remove the remaining sand well by rinsing. Otherwise, scratches may occur, causing leakage.

(6) Reinstall the sand filter and fix it with the fixing screws.

(7) Replenish the filter cylinder with sand to scale marking <10>.

(8) Reinstall the top cover on the sand filter, open the sample water valve(s) and cleaning water valve to start supplying sample water and cleaning water.

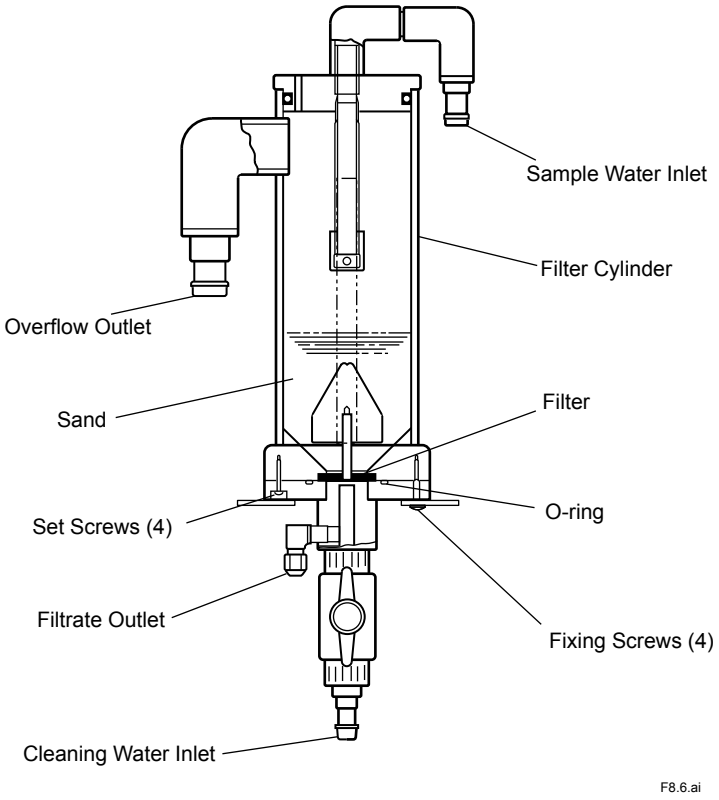


Figure 8.6 Inspection and Maintenance of Sand Filter

8.10 Inspection of Electrode Mechanism Block and Replacement of Damaged Parts

Parts used in the detector's electrode mechanism block, such as a motor assembly and rotating shaft assembly, have a limited service life. Their service life may be reduced unless they are used in appropriate condition. The electrode mechanism block should be checked regularly to ensure proper operation. The check is conducted effectively by combining full check and quick check. In a full check components are checked thoroughly to ensure that no failure has occurred and a quick check is conducted at the time of calibration or other maintenance work.

It is recommended that components be replaced at recommended replacement intervals. Table 8.2 shows items that need periodic inspection/maintenance and replacement.

Table 8.2 Periodic Inspection/Maintenance and Replacement Parts

Item	Inspection Intervals Full Check/Quick Check	Recommended Replacement Intervals
Brush and slip ring	3 months	2 years or if characteristic without range
Drive belt	6 months/3 months	3 years (operating time)
Driven shaft assembly	6 months/3 months	3 years (operating time)
Motor assembly/gear head	6 months/3 montsh	3 years (operating time)

8.10.1 Inspection, Maintenance and Replacement of Brush and Slip Ring

NOTE

Do not touch the brush except when replacement is performed.

Inspection and Maintenance Procedure

Remove the cover of the electrode mechanism block for inspection and maintenance. The inspection and maintenance should be performed in time with other maintenance work, such as polish of rotating gold electrode. The recommended interval is three month.

- Visually inspect the slip ring on the driven shaft and the brush contacts that are in contact with the slip ring, to ensure that no wear or failure has occurred.
- Measure the resistance between the brush wiring terminal (a fixing screw) and the driven shaft (place under the slip ring) using a tester. With the rotating gold electrode rotating, the resistance must be stable within the range of 500 Ω or less. If the resistance exceeds 500 Ω, wipe off dirt or stain on the slip ring using a cotton swab soaked in alcohol or by appropriate means. Then, re-measure the resistance.

Replacement Procedure

If any defects, such as wear of the slip ring or a bend of the brush, are observed, or if the resistance between the brush wiring terminal and the driven shaft still exceeds 500 Ω after wiping, the slip ring and brush should be replaced. The replacement, in principle, should be conducted by Yokogawa's service person. The replacement procedure is described below just in case the replacement is conducted by the user.

(1) Turn off the switch installed in the power line to stop the operation of the RC400G.

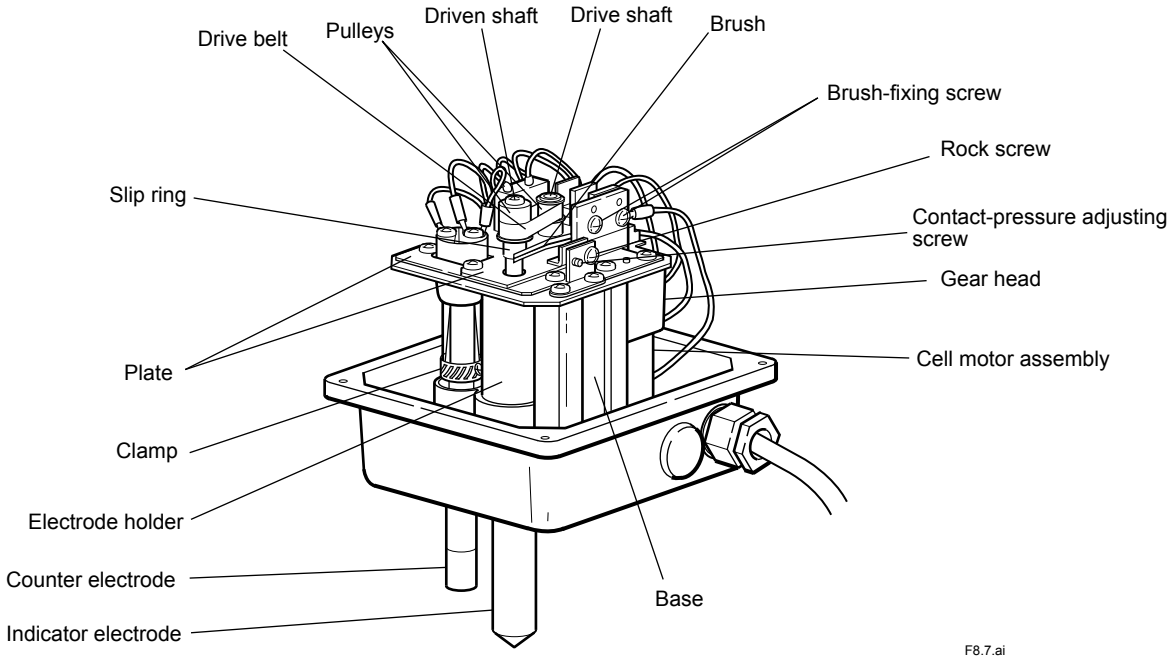


Figure 8.7 Electrode Mechanism Block

(2) Remove the brush by loosening the two screws (one serves as a wiring terminal screw) holding the brush.

(3) Remove the two pulleys of the drive shaft (cell motor shaft) and the driven shaft (indicator electrode mounting shaft).

The driven shaft pulley can be removed by inserting an Allen wrench (2 mm nominal, supplied) into the hole in the shaft, which is used as a lock, and unscrewing the end of the driven shaft.

The drive shaft pulley can be removed by loosening the two set screws using an Allen wrench (1.5 mm nominal, supplied).

Remove the pulleys by pulling them out together with the drive belt.

(4) Pull out the slip ring from the driven shaft and install a new one.

(5) Reinstall the pulleys and drive belt.

(Note) Mount the drive shaft pulley so that it is 0.3 to 0.7 mm from end of the shaft.

(6) Install a new brush, taking care not to deform it. Align the hole in the brush with the positioning pin on the bracket and fix the brush with the two screws. After installing, make sure that the brush contacts are in contact with the slip ring and that the brush itself is not in contact with the pulleys. If the brush contacts are not in contact with the slip ring, change the position of the brush mounting bracket so as to bring the brush contacts into contact with the slip ring.

● Adjustment of the Brush Contact Pressure

- Slightly loosen the two screws holding the brush mounting bracket, and then further loosen the lock screw adjacent to the contact pressure adjusting screw.
- Screw in the contact pressure adjusting screw while drawing the brush mounting bracket toward you by hand until the optimum brush contact pressure is achieved. This is achieved when the contact pressure adjusting screw is turned by three and half turns more after the brush has contacted with the slip ring. Confirm the contact of the brush with the slip ring by, for example, measuring the resistance using a tester.
- After positioning, tighten the lock screw. Also, tighten the fixing screw for the brush mounting bracket.

(7) Supply power to the RC400G. Check that drive shaft, drive belt, and driven shaft rotate smoothly. Also, check that abnormal sounds, such as resonant sound or discontinuous sound, are not heard.
Check the resistance between the brush wiring terminal and the driven shaft using a tester. The resistance must be 500 Ω or less.

Replacement of the brush and slip ring is now complete.

8.10.2 Inspection, Maintenance and Replacement of Drive Belt

● Inspection and Maintenance Procedure

The following inspections should be performed in time with other maintenance work which is performed with the cover of the electrode mechanism block open, e.g., polish of indicator electrode, to check the condition. The recommended interval is three month.

- Check for the presence of drive belt shavings on the motor mounting plate and the vicinity. If the materials have been deteriorated or if misalignment between the pulley and the drive belt has occurred, more drive belt shavings will be produced.
- Rotate the driven pulley clockwise and counterclockwise by hand. Check that rotation is transmitted to the drive shaft by small play. If the drive belt has lost tension, large play is needed for the rotation of the drive shaft.

The following inspections and maintenance should be performed approximately every six months.

- Check the drive belt for cracks due to material deterioration. If significant cracks are found, replacement is recommended.
- Check the drive belt tooth profile for abnormal trace (significant wear, peeling, etc.). If abnormal trace is found, replacement is recommended.
- Check the pulleys of the drive shaft and driven shaft for drive belt shavings deposits. If there are deposits that may interfere with the pulley operation, remove and clean them. Also, clear away drive belt shavings fallen on the motor mounting plate and the vicinity.

Replacement Procedure

After drive belt replacement, the tension should be adjusted. Without tension adjustment, negative effects, such as shorter life of the drive belt, may result. Tension adjustment is relatively time-consuming, so it is recommended that the drive belt be replaced in time with other maintenance work such as replacement of driven shift assembly or motor assembly unless replacement is urgently needed, i.e., if the drive belt causes abnormal operation of the electrode mechanism block. For drive belt replacement, refer to Items (14) and (15) in subsection 8.10.3.

8.10.3 Inspection, Maintenance and Replacement of Driven Shaft Assembly

Inspection and Maintenance Procedure

With the electrode mechanism block working at the time of, for example, zero calibration, the following inspections should be conducted. The recommended interval is three month.

- Check for abnormal sounds: loud sound, resonant sound or discontinuous sound. If abnormal sound occurs, defect bearings in the driven shaft assembly are likely. (Other causes, such as a defect in the motor, are also likely.) Stop the operation of the electrode mechanism block and check for friction in the driven shaft. (Refer to the instructions described below in biannual inspections.)
- Check for vibration of the driven shaft and indicator electrode. If vibration occurs, wear of bearings in the driven shaft assembly are most likely. Stop the operation of the electrode mechanism block and check for looseness between the driven shaft and the bearings. (Refer to the instructions described below in biannual inspections.)

The following inspection should be performed approximately every six months. Stop the operation of the electrode mechanism block for the inspection.

- Turn the driven shaft by hand and check to ensure smooth rotation without looseness. If looseness occurs, if the driven shaft does not rotated by inertial force with the drive belt removed, or if friction sound is heard, immediately replace the driven shaft assembly.

Replacement Procedure

If failure of bearings occurs, the whole driven shaft assembly, including the bearings, should be replaced. The replacement, in principle, should be conducted by Yokogawa's service person. The replacement procedure is described below just in case the replacement is conducted by the user. Steps (1) to (9) are a disassembly procedure and steps (10) and the following steps are an assembly procedure.

(1) Shut off the power fed to the RC400G, then place the electrode mechanism block in the maintenance position then remove the cover (see Figure 4.7).

(2) Remove indicator electrode and counter electrode.
To remove the indicator electrode, inset the supplied hex key wrench into the socket of the driven shaft, to stop it from rotating.
Disconnect the three wires connected to the counter electrode, next loosen and remove the clamp holding the electrode in its holder.

(3) Remove the brush by loosening the two screws (one serves as a wiring terminal screw) holding the brush.

(4) Remove the bracket which holds the brush by loosening the 2 screws which holds the bracket, and remove the rock screw at side of contact-pressure adjusting screw.

(5) Remove the drive belt together with the pulleys for the driven and drive shafts.

(6) Remove the slip ring from the driven shaft.

(7) Remove the plate installed to prevent drive belt shavings to enter the electrode holder in the driven shaft assembly by loosening the 2 screws.

(8) Remove two plates which holds driven shaft assembly in place.

(9) If driven shaft assembly is bad, remove it from motor mounting plate. The place where the electrode holder base is inserted contains an O-ring. This O-ring and the counter electrode fixing clamp can be reused.

NOTE

It is recommended that an O-ring (P/N Y9115XB) be replaced after 3 years even if no damage has occurred.

Step (10) and the following steps are an assembly procedure. Keep the following in mind when assembling the driven shaft assembly.

- Before assembly, clean away dirt or stains on each component.
- Assemble the assembly so that the drive belt tension is 4 N (spring balance reading of 0.4 kgf).
- Assemble the assembly so that the indicator electrode does not make contact with the base.

(10) Mount a new driven shaft assembly on the motor mounting plate. First, install the clamp and O-ring in the electrode holder in the driven shaft assembly. The O-ring should be installed in the position of approximately 4 mm from the end of the electrode holder. Next, mount the driven shaft assembly on the motor mounting plate, taking care not to allow the O-ring to protrude from the hole in the base.

(11) Install the plate to hold the driven shaft assembly. Make sure that the four pins are installed in the plate. Here, temporarily tighten the two screws on the long sides.

(12) Install the plate for preventing drive belt shavings to enter the electrode holder. With the surface with the two tabs facing downward, pass the plate through the driven shaft. Align the tabs with the holes in the plate installed in step (11) and temporarily tighten the two screws.

(13) Install the slip ring in the driven shaft.

NOTE

The contact surface between the driven shaft and the slip ring needs an electrical connection. Make sure that the contact surface is clean.

(14) Install the pulleys with drive belt attached to the drive and driven shafts.

NOTE

The drive pulley should be installed so that the end of the shaft poke out 0.3 to 0.7 mm (so that the drive belt is positioned horizontally).

(15) While adjusting the drive belt tension, further tighten the screws that were tightened temporarily in steps (11) and (12). Hang the hook of a spring balance (1.00 kg) on the hole in the

driven shaft. Make sure that all the temporarily tighten four screws are loose. Then, draw the drive belt horizontally in the direction of the line that connects between the drive shaft and the driven shaft, by a force of 4 N (spring balance reading of 0.4 kgf). With this tension kept, tighten the screws completely.

(16) Install the indicator electrode in the driven shaft. Check that the indicator electrode does not make contact with the base.

NOTE

If the indicator electrode makes contact with the base or if the center of the hole in the base and the center of the indicator electrode are misaligned largely, loosen the four screws holding the motor mounting plate to the base and adjust the positions.

(17) Install the reference (counter) electrode, make the wiring connections, and fix it with the clamp.

(18) Install the brush and bracket which holds the brush. If the screws holding the motor mounting plate have been loosened in step (16), set the contact pressure adjusting screw so that the brush makes contact with the slip ring at an optimum contact pressure. (See subsection 8.10.1.)

Replacement is now complete. After supplying power to the RC400G, make sure that the drive shaft, drive belt, and driven shaft rotate smoothly. Also, check that abnormal sounds (resonant sound, discontinuous sound, etc.) are not heard.

8.10.4 Inspection, Maintenance and Replacement of Motor Assembly/Gear Head

Inspection and Maintenance Procedure

With the electrode mechanism block working at the time of, for example, zero calibration, the following inspections should be conducted. The recommended interval is three month.

- Check there's no irregularity in rotation speed of drive shaft. If there's any irregularity, loose the load on the shaft by loosening the screws which fix the driven shaft pulley, and recheck. If there is still irregularity, replace motor assembly and gear head. If the irregularity doesn't reappear, check the driven shaft assembly.
- Abnormal sound from gear head (motor).
  If there's any abnormal sound, check the motor assembly / gear head. (In principle, this should be done by Yokogawa).

The following inspection should be performed approximately every six months.

- Motor rated torque and drive torque.
  In <CELL> mode, when motor is turned ON/OFF, after the ON command it should quickly reach speed. Confirm that the difference in speed of rotation between its normal status, and when load is reduced by loosening screws fixing pulley to driven shaft, is not noticeable.
  If operation is still not satisfactory, replace motor assembly and gear head.

Replacement Procedure

Replacement of the motor assembly/gear head, in principle, should be conducted by Yokogawa. If the replacement is conducted by the user, the following should be noted.

- In principle, replace motor assembly and gear head at the same time as periodic replacement of other parts. Replace complete motor assembly consisting of both motor and capacitor.

- When replacing motor assembly and gear head, first remove motor mounting plate from base.

  There are no special cautions relating to removal of, or reassembly of, motor assembly and gear head, however the parts such as electrode, brushes and drive belt removed when removing motor assembly from mounting plate should be carefully reassembled, referring to 8.10.1 through 8.10.3, so as not to make any mistakes in reassembly.

- The terminal board within motor assembly should be set same position of “C1” and “C2 ” printed on the plate, which wire color of “C1” is yellow/green and “C2” is pink/black.

8.10.5 Replacement of Activated Charcoal Filter

Stop supplying sample water by closing the main valve.

1. Remove the filter case by turning it in the direction shown below.
2. Clean the inside of the case with a brush or appropriate tool.
3. Replace the filter with a new one.
4. Reverse the above steps to assemble.
5. Turn on the solenoid valve SV6 to allow chlorine-free water to run for at least 30 minutes. Check that there is no leakage.
6. Check that the reading approximates to zero.

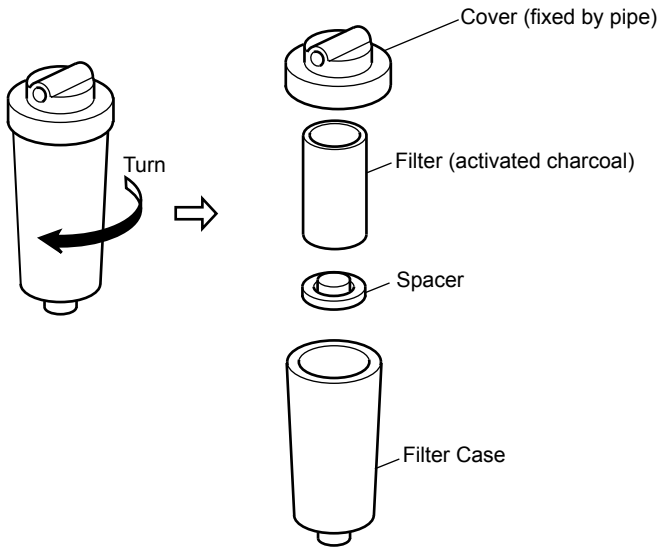


Figure 8.8 Replacing Activated Charcoal Filter

9. Troubleshooting

Routine maintenance work for keeping good operating conduction was described in Section 8. Maintenance work for failures is described in this section.

Failure conditions are divided into the following three patterns:

(1) Only error messages are indicated in the operations of calibration, plateau characteristics collection or data setup.

(2) On <failure> detection, <FAIL> lamp is lit and <failure> contact signal is sent.

(3) <failure> is not detected, but normal measurement is hampered.

9.1 When <failure> is Indicated.

9.1.1 Indication of Error Message or Error Code During Operation

Types of <failure> during operation and respective error messages/error codes are listed in Table 9.1.

Except for “Err16” and “Err17”, these <failure>s are indicated only by error messages or error codes, without accompanying <FAIL> light or <failure> contact signal.

Table 9.1 <failure> during Operation

Operation	Error Code	Type of <failure>	<failure> Indication Reset Action
Zero calibration (See subsection 7.2)	Err21 Err23	Zero point failure Response failure	Press [ENT] key Press [ENT] key
Span calibration (See subsection 7.3)	Err22 Err23 not	Sensitivity failure Response failure Calibration input value out of allowable range	Press [ENT] key Press [ENT] key Press [>] key
Metering pump flow rate measurement (See subsections 4.3.5 and 4.3.6)	Error	"Stopwatch" operation incomplete	Press [ENT] key
Plateau characteristics collection (See subsection 5.3.3 (6))	not	Voltage, etc. input value out of allowable range (not enterable)	Press [>} key
Data setup in PROGRAM-1 or -2 mode (See subsections 5.3.4 and 5.3.5)	not	Input value out of allowable range (not enterable)	Press [>} key
Power ON operation	Err16 (note 1) Err17 (note 1)	Memory <RAM> failure Memory (EEPROM) failure	Not possible Not possible

(Note 1) Described in subsection 9.1.2 (7).

When <failure> has occurred during operation, treat as follows depending on the error message or error code indicated.

(1) Error message “not”:

The value input exceeds allowable setup range. Re-setup.

Note: Refer to Tables 5.5 and 5.6 for allowable setup range.

(2) Error message “Error”:

<On metering pump flow rate measurement operation>

When 360 seconds has passed after starting flow rate measurement (time measurement) by pushing [ENT] key, the error message appears unless the [ENT] key is re-pressed within 360 sec. If the metering pump fails to deliver a specified volume in 360 seconds, proceed with the inspection flow given below.

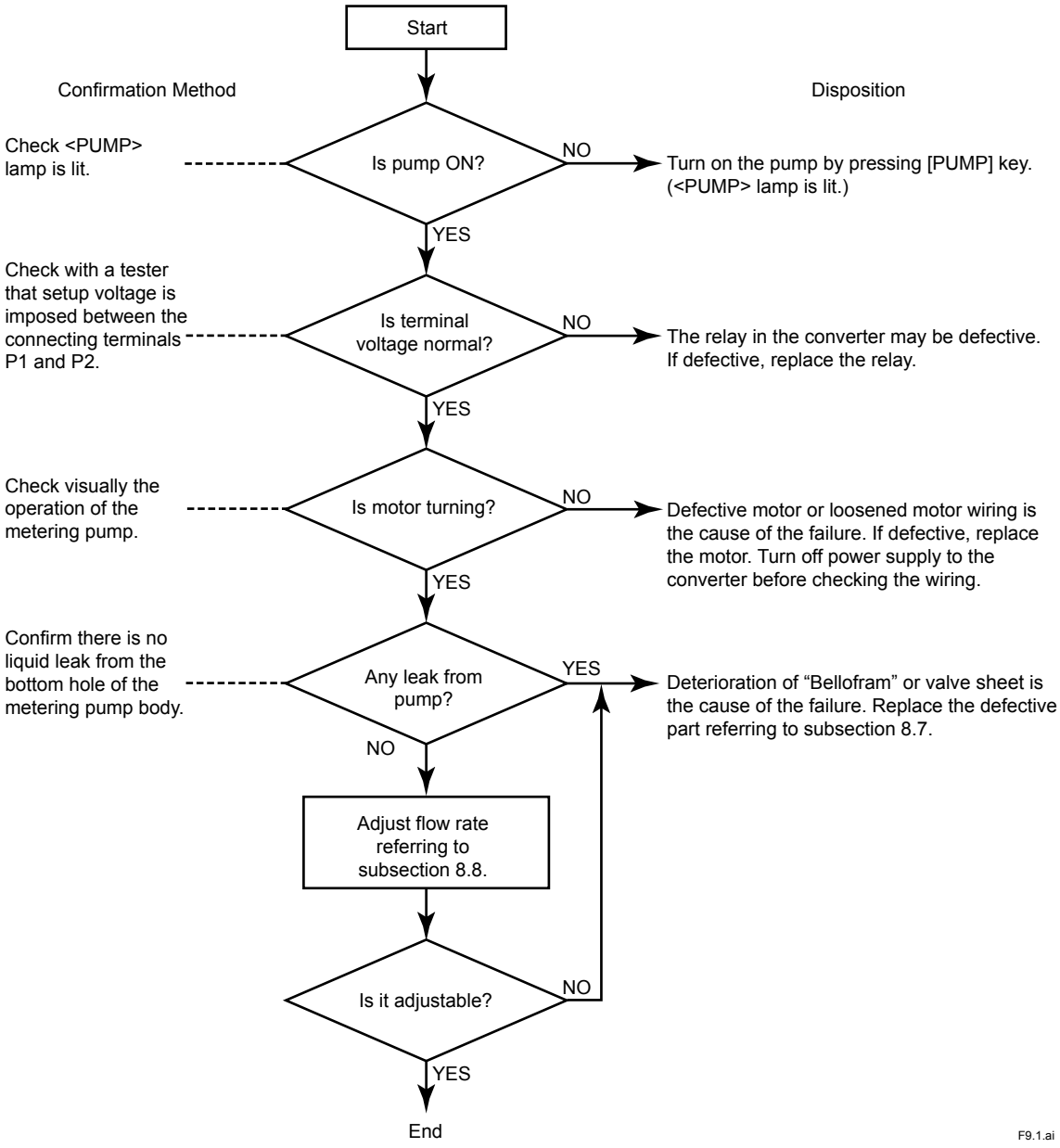

Start
Confirmation Method
Disposition
Check <PUMP> lamp is lit.
Is pump ON?
NO
Turn on the pump by pressing [PUMP] key. (<PUMP> lamp is lit.)
YES
Check with a tester that setup voltage is imposed between the connecting terminals P1 and P2.
Is terminal voltage normal?
NO
The relay in the converter may be defective. If defective, replace the relay.
YES
Check visually the operation of the metering pump.
Is motor turning?
NO
Defective motor or loosened motor wiring is the cause of the failure. If defective, replace the motor. Turn off power supply to the converter before checking the wiring.
YES
Confirm there is no liquid leak from the bottom hole of the metering pump body.
Any leak from pump?
YES
Deterioration of “Bellofram” or valve sheet is the cause of the failure. Replace the defective part referring to subsection 8.7.
NO
Adjust flow rate referring to subsection 8.8.
Is it adjustable?
NO
YES
End
F9.1.ai

Figure 9.1 Metering Pump Inspection Flow Chart

(3) Error code “Err21” (zero point failure):

Carry out the inspections described below in accordance with the zero calibration method.

<Open input circuit method>

Confirm that the space between the indicator electrode (rotating gold alloy electrode) and the counter electrode is completely open.

<Chlorine-free water method>

(a) Check by amperometric titration, etc. that the zero calibration liquid in use is chlorine-free water.

(b) Confirm that reagent is present in the reagent tank.

(c) Confirm the operation of the metering pump following the inspection flow chart shown in Figure 9.1.

(4) Error code “Err22” (sensitivity failure):

Conduct inspection following the inspection flow chart shown in Figure 9.2.

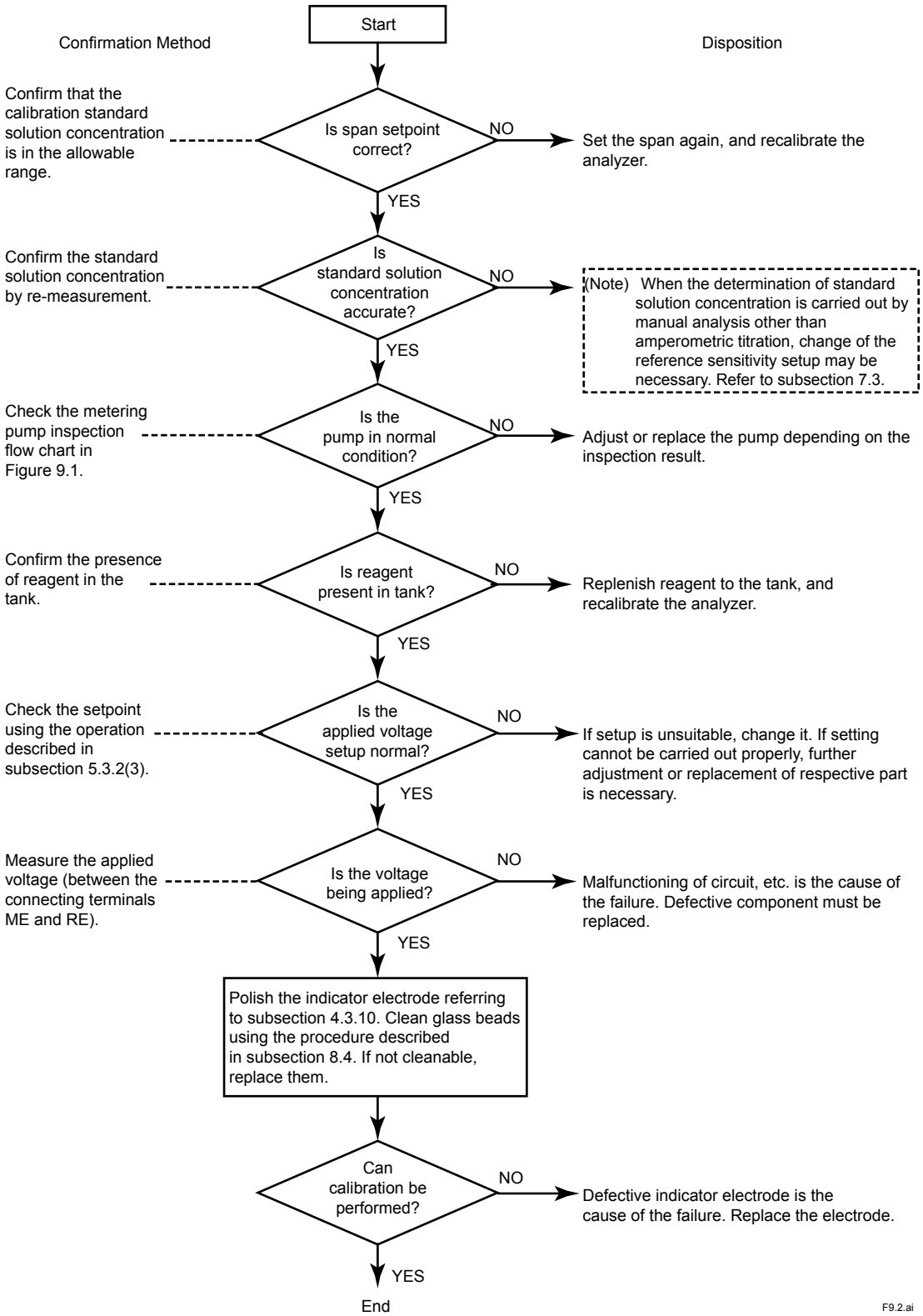

Start
Confirmation Method
Disposition
Confirm that the calibration standard solution concentration is in the allowable range.
Is span setpoint correct?
NO
Set the span again, and recalibrate the analyzer.
YES
Confirm the standard solution concentration by re-measurement.
Is standard solution concentration accurate?
NO
(Note) When the determination of standard solution concentration is carried out by manual analysis other than amperometric titration, change of the reference sensitivity setup may be necessary. Refer to subsection 7.3.
YES
Check the metering pump inspection flow chart in Figure 9.1.
Is the pump in normal condition?
NO
Adjust or replace the pump depending on the inspection result.
YES
Confirm the presence of reagent in the tank.
Is reagent present in tank?
NO
Replenish reagent to the tank, and recalibrate the analyzer.
YES
Check the setpoint using the operation described in subsection 5.3.2(3).
Is the applied voltage setup normal?
NO
If setup is unsuitable, change it. If setting cannot be carried out properly, further adjustment or replacement of respective part is necessary.
YES
Measure the applied voltage (between the connecting terminals ME and RE).
Is the voltage being applied?
NO
Malfunctioning of circuit, etc. is the cause of the failure. Defective component must be replaced.
YES
Polish the indicator electrode referring to subsection 4.3.10. Clean glass beads using the procedure described in subsection 8.4. If not cleanable, replace them.
Can calibration be performed?
NO
Defective indicator electrode is the cause of the failure. Replace the electrode.
YES
End
F9.2.ai

Figure 9.2 Sensitivity Failure Inspection Flow Chart

(5) Error code “Err23” (response failure):

Reset the response failure detection limit at a larger value (referring to subsection 5.3.4 (4)), and recalibrate the analyzer. If error is still displayed after changing the limit value, confirm the applied voltage.

Measure the voltage between the connecting terminals ME and RE with a voltmeter of input resistance 1 MΩ or mode with ME terminal positive and RE terminal negative.

When the voltage is stable in the range of ±20 mV, it is normal. If not, it is attributable to a defective voltage applying circuit. Replace the circuit board assembly on which the respective circuit is located.

9.1.2 <FAIL> Lamp Lit

Types of <failure> which turn on <FAIL> lamp and respective error codes are listed in Table 9.2.

“Err13”, “Err24” and “Err25” are detected only when “execution of failure detecting function” is selected. When <FAIL> lamp is lit, confirm the error codes may be displayed simultaneously.

Table 9.2 Types and Error Codes of <failure> which are followed by <FAIL> Lamp Lighting

Error Code	Type of <failure>	Resetting <failure> Display
Err11	Concentration range exceeded	Can be reset by the operation described in subsection 5.3.3 (9).
Err12	Sample temperature failure	
Err13	Out-of-sample in the measuring tank	
Err14	Converter failure (AD circuit failure)	
Err15	Converter failure (Memory comparison failure) *1	
Err24	Temperature compensation range exceeded	
Err25	Concentration upper limit setpoint exceeded	

*1: Once turn OFF and then ON power for reseting error display.

(1) Error code “Err11” (Concentration range exceeded), Error code “Err25” (Concentration upper limit setpoint exceeded)

Reset error once using the operation of subsection 5.3.3 (9).

If <FAIL> lamp lights again after resetting the error, perform the following inspection. However, on simultaneous occurrence of “Err11” and “Err14”, conduct the inspection “Err14”.

(a) Calibration of zero point or span may have been performed incorrectly. Perform calibration again.

After calibration, operate resetting of <failure> display.

(b) If <FAIL> lamp lights even after operation (a) above, failure of the temperature sensor built in the counter electrode is considered to be the cause of the abnormally (temperature is not compensated correctly). Conduct inspection following the inspection flow shown in Figure 9.3.

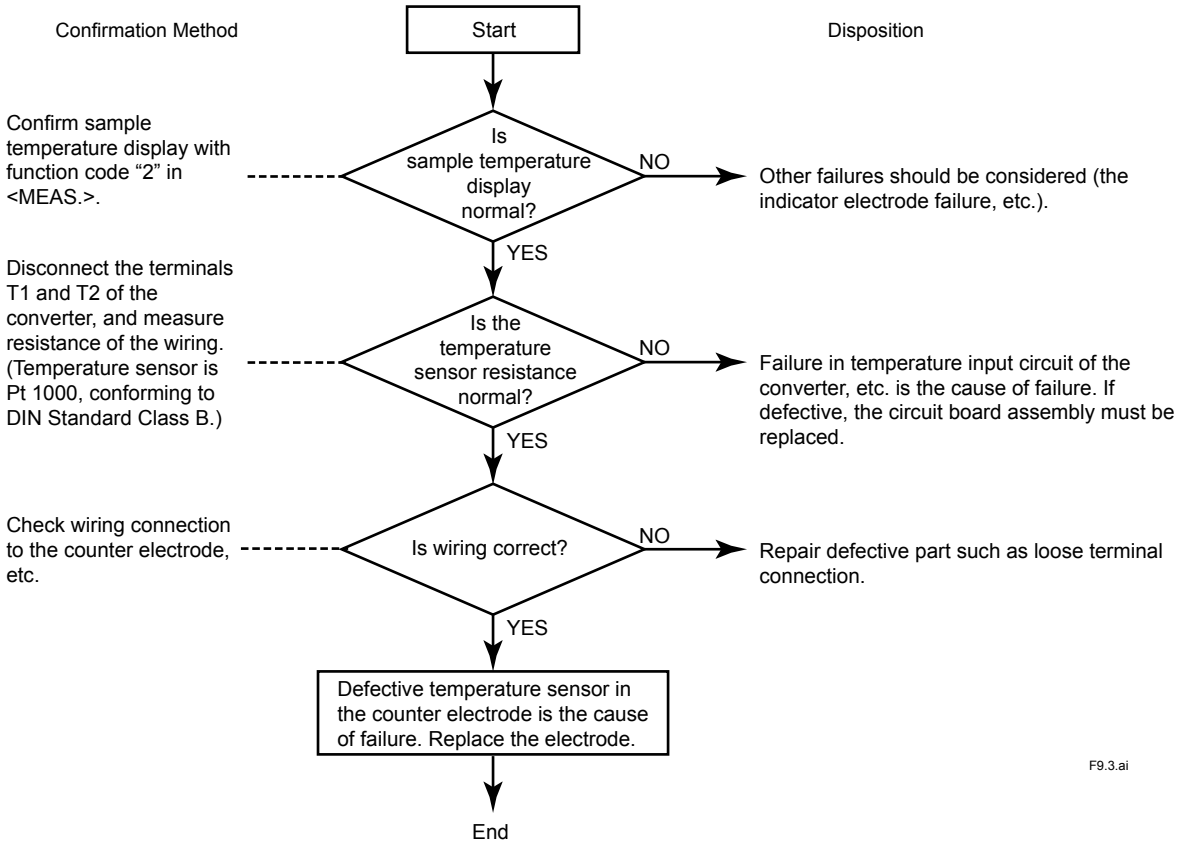

Confirmation Method
Start
Disposition
Confirm sample temperature display with function code “2” in <MEAS.>.
Is sample temperature display normal?
NO
Other failures should be considered (the indicator electrode failure, etc.).
YES
Disconnect the terminals T1 and T2 of the converter, and measure resistance of the wiring. (Temperature sensor is Pt 1000, conforming to DIN Standard Class B.)
Is the temperature sensor resistance normal?
NO
Failure in temperature input circuit of the converter, etc. is the cause of failure. If defective, the circuit board assembly must be replaced.
YES
Check wiring connection to the counter electrode, etc.
Is wiring correct?
NO
Repair defective part such as loose terminal connection.
YES
Defective temperature sensor in the counter electrode is the cause of failure. Replace the electrode.
F9.3.ai
End

Figure 9.3 Inspection Flow Chart for Concentration Failure

If cause(s) of the failure is(are) known, repair defective parts and reset <failure> display.

(2) Error code “Err12” (Sample temperature failure), Error code “Err24” (Temperature compensation range exceeded)

When <failure> of error code “Err12” is detected, “Err24” is also detected at the same time in many cases. In such case, conduct inspection for “Err24”.

When <failure> has been detected, reset the error once. After resetting, if the error is detected again, perform inspection following the inspection flow in Figure 9.4.

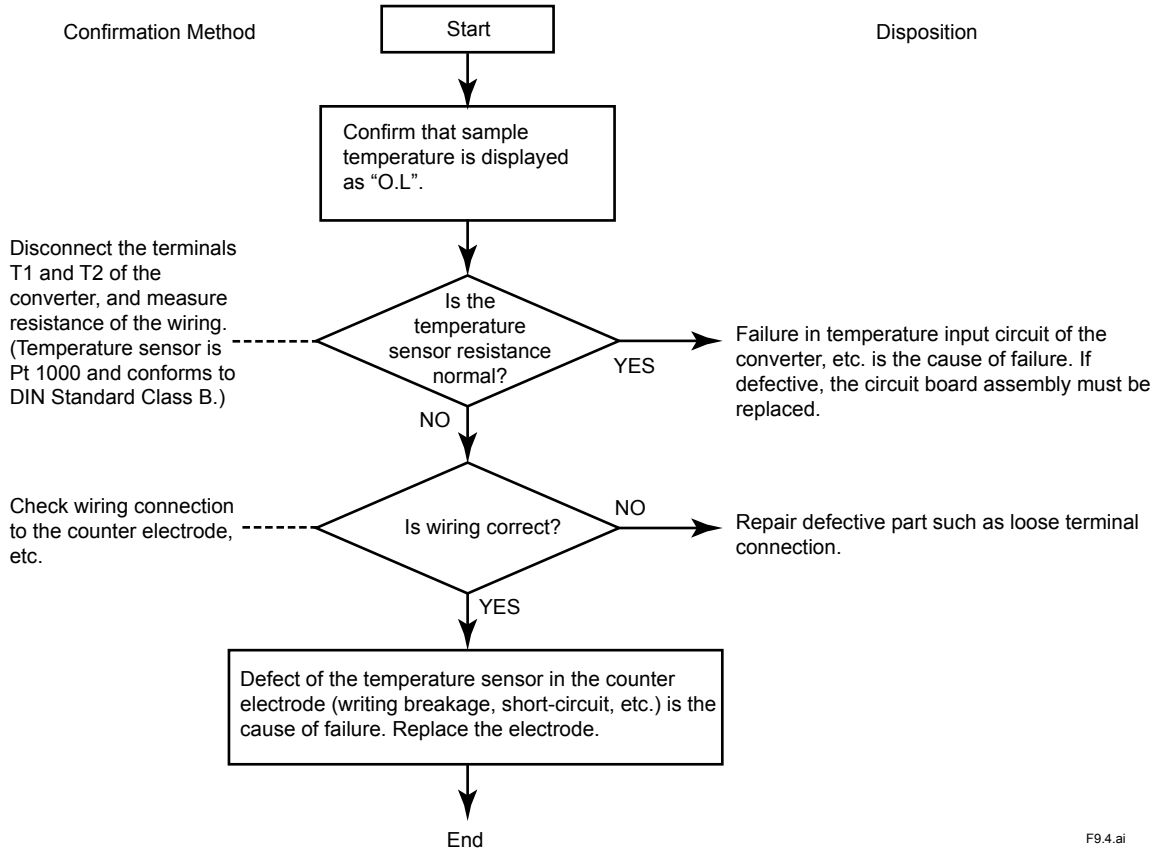

Confirmation Method
Start
Disposition
Confirm that sample temperature is displayed as “O.L”.
Disconnect the terminals T1 and T2 of the converter, and measure resistance of the wiring. (Temperature sensor is Pt 1000 and conforms to DIN Standard Class B.)
Is the temperature sensor resistance normal?
YES
Failure in temperature input circuit of the converter, etc. is the cause of failure. If defective, the circuit board assembly must be replaced.
NO
Check wiring connection to the counter electrode, etc.
Is wiring correct?
NO
Repair defective part such as loose terminal connection.
YES
Defect of the temperature sensor in the counter electrode (writing breakage, short-circuit, etc.) is the cause of failure. Replace the electrode.
End
F9.4.ai

Figure 9.4 Temperature Failure Inspection Flow Chart

(3) Error code “Err13” (Out-of-sample in the measuring tank)

No sample water is supplied to the measuring tank.

Find out the cause by inspecting the following items.

(a) Check that tubing is securely connected.

(b) Check the metering pump operation following the inspection flow of Figure 9.1.

(c) For the RC400G-3 analyzers for treated water, check the operation of the solenoid valves (SV3 and SV4). Check if the solenoid valves function by operating [SV3] and [SV4] keys in <MEAS.> mode. If the valves do not operate, check the voltage between the solenoid valve (SV3) connecting terminals V1 and V2 or between V3 and V4 of the valve (SV4) with a multimeter if power is applied in the ON state.

If no power is applied in the ON state, there is a failure in electric circuits in the converter such as a defective relay. If the voltage is applied, the solenoid valve(s) is(are) defective.

After repairing defective parts, reset <failure> display. (Refer to subsection 5.3.3 (9).)

Confirm the supply of sample water into the measuring tank, and then the mode to <MEAS.>.

(4) Error code “Err14” (Converter failure)

When <failure> of error code “Err14” is displayed, once reset <failure> display, and confirm that <failure> display appears again.

This <failure> detection is carried out in a slightly longer frequency. Wait about 2 minutes to confirm the recurrence of <failure>.

If <failure> is displayed again, perform the inspection following the flow chart of Figure 9.5.

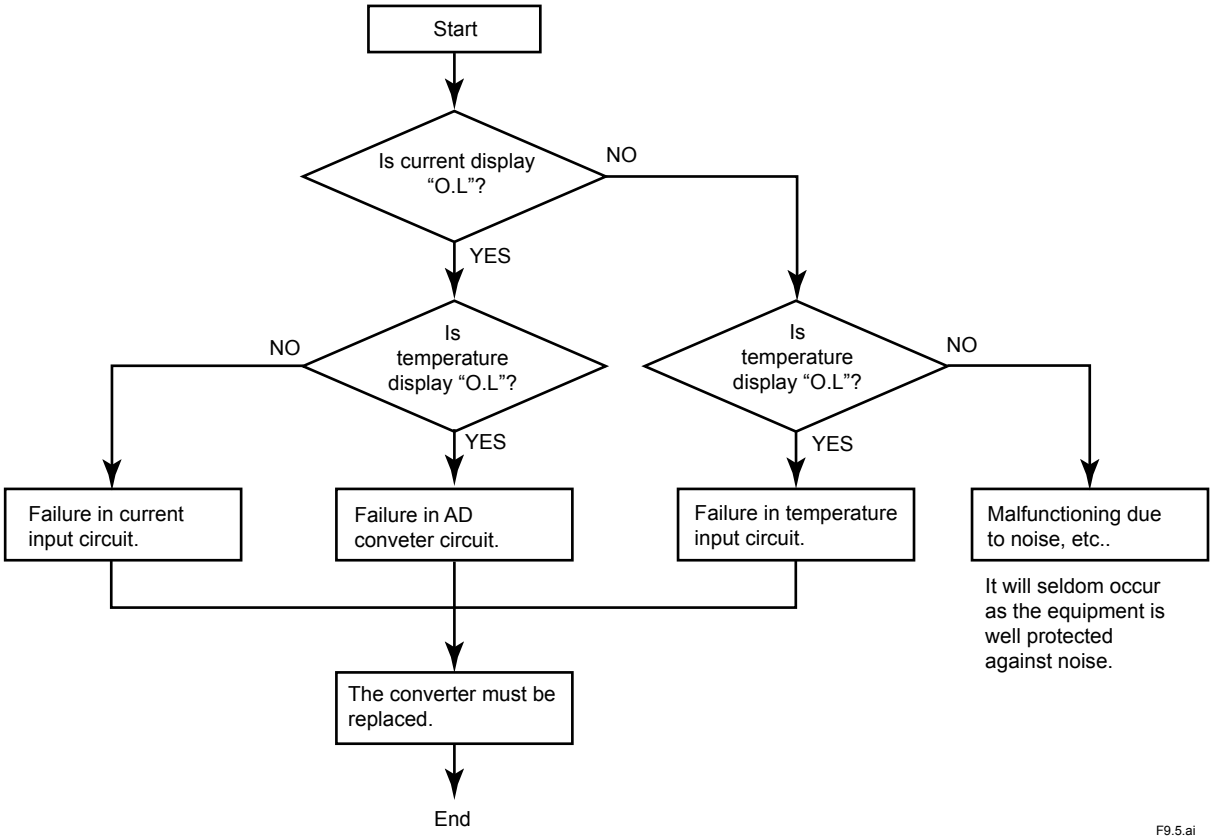


Figure 9.5 Converter Failure Inspection Flow Chart

(5) Error code "Err15" (Converter failure)

<failure> of error code "Err15" is displayed when failure occurs in EEPROM memory storing setup data.
When this <failure> is displayed, once reset the display and confirm if the <failure> is detected again.
If <failure> display appears again, memory content initialization is necessary.
Memory content initialization is carried out by the procedure given below. Notice, however, that when memory content is initialized, re-setup of calibration factor (for zero point and span), adjustment factors for analog output and current input, etc. as well as setup data becomes necessary. As setting except for the setup of calibration factor must be made in "service mode", contact Yokogawa when the <failure> described above has occurred.

(a) Once turn the converter power OFF.

(b) Turn power ON again. Display change as shown below.

(Power ON) => "CHEC" => "dFt" => with function code "1" in <MEAS.> mode
(momentary indication) (initialization: about 15 sec)

Note: Display of "Err17" when power is ON means that EEPROM itself is in an unusable condition.

(c) Reset <failure> display, and confirm that <failure> is not indicated again.

When memory contents in EEPROM is initialized, the stored setting date is also initialized.

(6) Error code "Err25" (Concentration upper limit setpoint exceeded)

Usually, independent display of error code "Err25" <failure> appears when chlorine concentration in sample water exceeds the set value, but does not mean equipment failure.

“Err25” <failure> therefore serves as a common “upper limit alarm”. However, <failure> output is not reset even when chlorine concentration reduces below the set value. Reset the display by the error resetting operation (see subsection 5.3.3 (9)).

(7) Error code “Err16” or “Err17” (Converter failure)

<failure> of error code “Err16” or “Err17” is detected only a moment immediately after power has been supplied to the converter.

When this <failure> is displayed, turn off power once.

If <failure> display (see Figure 9.6) is observed when power is turned ON again, RAM or EEPROM is defective. Replace the circuit board assembly carrying these components.

“CHEC” => “Err16” (defective RAM)
(momentary indication)

“CHEC” => “dFt” => "Err17" (defective EEPROM)
(momentary indication) (indicated for about 15 sec
Initial values are written.)

Figure 9.6 Error Display in Power ON

When memory contents in EEPROM is initialized, the stored setting date is also initialized.

9.2 Operation Failures in Measurement Without <failure> Detection

Phenomena which hamper normal measurement, such as measured value fluctuation, can take place without detection of <failure>. Possible failure symptoms, causes and corrective actions are described in Table 9.3.

Table 9.3 Causes and Corrective Actions for Operation Failures in Measurement

Symptoms	Possible Causes	Corrective Actions
Measured value is abnormal.	1. Reagent is not mixed with sample water. a. No reagent in the reagent tank. b. Reagent metering pump failure	 1. a. Supply reagent to the reagent tank. 1. b. Check delivery flow rate. If flow rate is not in specified range, adjust it. Replace defective "Bellofram" or valve sheet, if there is any damage.
	2. The indicator electrode is not rotating. a. The drive belt of the electrode drive is not turning. b. The cell motor does not turn.	 2. a. Tighten the set screw. 2. b. Replace the motor with a new one.
	3. The indicator electrode is worn and damaged.	3. Replace the electrode with a new one.
	4. Electric resistance between the rotating shaft and the brush is high.	4. Inspect and maintain them according to subsection 8.10. (Checking method: Measure the resistance between the rotating shaft and the brush with a multimeter. If the result is 500 Ω or less, it is normal.) a. Adjust the brush contact pressure and remove wear debris from slip ring. (Refer to subsection 10.2.11) b. Rreplace the brush and/or slip ring. (Refer to subsection 8.10.1)
	5. Failure of the temperature sensor in the counter electrode.	5. Replace the counter electrode. (Checking method: Measure resistance between the conductors T1 and T2 of the electrode cord. It should be about 1078 Ω at 20°C. If resistance value changes with temperature, it is normal.)
	6. Current leaks from the input circuit.	6. Check the electrode mechanism block for insulation failures and fix if any. (Checking example: between the brush and bracket)
Measurement error is large.	1. The electrodes, especially the indicator electrode, is contaminated.	1. Polish the indicator electrode referring to subsection 4.3.10, and clean glass beads referring to subsection 8.4. (If not cleanable, replace them.)
	2. Zero point and span are not properly calibrated.	2. Calibrate zero point and span.
	3. Sand adsorbs chlorine (when filter sand in the sand filter has been replaced).	3. Clean sand repeatedly before performing measurement. (total cleaning time: About 20 minutes)
No response, Slow response	1. The pump does not feed sample water.	1. Replace "Bellofram" or valve sheet.
	2. Deterioration of the filter capacity of the sand filter.	2. Improve performance referring to subsection 8.9.
Measured value fluctuates largely	1. The indicator electrode does not rotate at a constant speed.	1. Check the set screw for loosening. Replace the drive belt, driven shaft assembly etc. if defective.
	2. Incomplete conduction between the slip ring and the brush in the electrode mechanism block.	2. a. Adjust the brush contact pressure and remove wear debris from the slip ring. (Refer to subsection 10.2.11) 2 b. Replace the brush and slip ring. (Refer to subsection 8.10.1)
Measured value does not vary	1. Out-of-sample in the measuring tank. (detected by out-of-sample detection)	1. Restore detached tubing, abnormally of the metering pump, etc. to the normal status.
	2. Wire breakage between the electrodes.	2. Repair broken wiring. Replace electrode for wire breakage in the electrode.
	3. No voltage is applied between the indicator and counter electrodes.	3. Repair the converter. (Checking method: Measure voltage between connecting terminals ME(+) and RE(-) of the 1 MΩ or more. A result in the range of -0.40 ±0.02 V is normal.)

9.3 Other Failures

9.3.1 Analog Output does not Correspond to Indicated Value.

When analog output is abnormal whereas the display of residual chlorine concentration is normal, output circuit may have failed.

When an output range of 4 to 20 mA is used, confirm that load resistance is 550 Ω or less.

9.3.2 Cleaning is not Conducted Properly.

This problem may appear when the RC400G-2 or RC400G-3 is used.

When a symptom possibly caused by malfunctioning of the solenoid valve is observed, e.g. irregular cleaning of the “measuring tank/sand filter cylinder” or evidence of cleaning water mixing into sample water; check the operation of each solenoid valve in <MAINT.> mode.
Perform operation checking by operating each one of each “Operation command keys -2” corresponding to each solenoid valve.
When a solenoid valve does not work at all, check with a multimeter if the supply voltage for operating the solenoid valve is applied to the connecting terminals when the operation command is sent.
If the voltage is applied by operation command, the cause of malfunctioning is on the solenoid valve side.
Replace the solenoid valve after checking that wiring connection is not the cause of the failure.
Replace the solenoid valve also when cleaning water enters the measuring tank or the sand filter even the solenoid valve is not working.
The cycle of automatic zero calibration may coincide with that of cleaning. If so, automatic zero calibration will take precedence. Change either cycle.

9.3.3 “Remote” Range Switching does not Work.

This failure occurs when output range switching is performed in “Remote” position.

When the range is not switchable by the range switching command, check if the command signal (resistance of input contact) meets requirements. (Refer to subsection 3.3.3.)

10. Spare Parts and Consumables

10.1 Spare Parts and Consumables List

Name	Part No.	Description	Q'ty	Recommended replacement interval (*1)
JIS grade 1 acetic acid (CH_3COOH)	K9041TH	500 ml, for reagent preparation	1	(*2)
JIS grade 1 anhydrous sodium acetate (CH_3COONa)	K9041TG	500 g, for reagent preparation	1	(*2)
JIS grade 1 potassium bromide (KBr)	K9041TJ	500 g, for reagent preparation for free available chlorine measurement	1	(*2)
JIS grade 1 potassium iodide (KI)	K9041TQ	500 g, for reagent preparation for total residual chlorine measurement	1	(*2)
Indicator electrode (Rotating electrode)	K9334JP	Gold alloy electrode (*5)	1	Yearly
Counter electrode	K9332MJ	Reference electrode	1	(*3)
Counter electrode	K9332MK	Reference electrode (for combined chlorine)	1	(*3)
Glass beads	K9332ZJ	For cleaning indicator electrode. (2 bags/Q'ty)	1	Yearly
Polishing powder (Alumina)	K9088PE	For polishing indicator electrode	1	-
Brush	K9332JX	Part for electrode mechanism	1	2 years
Slip ring	K9332JZ	Part for electrode mechanism	1	2 years
Drive belt	L9804UK	Part for electrode mechanism	1	3 years
Driven shaft assembly	K9334JV	Part for electrode mechanism (*5)	1	3 years
O-ring	Y9115XB	Part for electrode mechanism	1	3 years
Motor assembly (100 V)	K9334JY	Part for electrode mechanism	1	3 years
Motor assembly (110 V)	K9334VQ	Part for electrode mechanism	1	3 years
Motor assembly (200 V)	K9334VR	Part for electrode mechanism	1	3 years
Motor assembly (220 V)	K9334VS	Part for electrode mechanism	1	3 years
Gear head (100 V / 110 V)	K9332JP	Part for electrode mechanism	1	3 years
Gear head (200 V/220 V)	K9334VA	Part for electrode mechanism	1	3 years
Fuse (1 A)	A1109EF	For electric circuit	1	Yearly (*6)
Fuse (3A)	A1113EF	For power supply	1	Yearly (*6)
Sand	K9720FZ	For sand filter unit (1liter)	1	yearly
Air pump (100 V)	K9087XA	For air purgepump	1	3 years
Air pump (110 V)	K9087XF	For air purgepump	1	3 years
Air pump (200 V)	K9087XG	For air purgepump	1	3 years
Air pump (220 V)	K9087XH	For air purgepump	1	3 years
Lubricating oil (engine oil)	K9041RA	For metering pump drive	1	1 month (*4)
Bellofram	L9819AA	For reagent pump	1	6 months
Bellopfram	L9819AB	For sample water pump	1	6 months
Valve sheet	K9041HC	For metering pump	1	6 months
Activated charcoal filter	L9862AY	For automatic zero calibration	1	Yearly
Filter	K9332NN	For head tank or sand filter	1	Yearly

(*1) Replacement intervals vary depending on the application.
(*2) Reagents are not imported from Japan because of both safety and transportation cost issues. Purchase them directly in your local reagent supplier.
(*3) At the time of damage
(*4) 30 ml, for lubricating the metering pump drive assembly
(*5) P/N changed by style S3.
(*6) Fuse may be used more than one year, we recommend periodical replace for planning maintenance.

10.2 Complementary Description

10.2.1 Reagent (K9041TH, K9041TG, K9041TJ, K9041TQ)

The reagent for free available chlorine measurement is prepared by acetic acid, anhydrous sodium acetate and potassium bromide. For making 100 liter of this reagent, 1000 mL of acetic acid, 1 kg of anhydrous sodium acetate and 4 kg of potassium bromide are required.
Reagent of 100 liter is approx. 45 days supply. Therefore, for a year supply, a quantity of 8 times the above is required. (K9041TH: 17 bottles, K9041TG: 16 bottles, K9041TJ: 64 bottles)
The reagent for total residual chlorine measurement is prepared by acetic acid, anhydrous sodium acetate and potassium iodide.
Quantities of each component vary with the measurement range. Refer to subsection 2.1.

10.2.2 Lubricating oil (K9041RA)

To maintain smooth operation of the metering pump drive assembly levers, use this lubricating oil on each bearing of the four lever support blocks once a month or so. One bottle of lubricating oil is supplied as an accessory. It can be used for some time as its use requires only about 0.4 ml at one time.

10.2.3 Polishing Powder (K9088PE)

This is used to remove contamination on the indicator electrode, as contamination cannot be prevented completely by automatic polishing with glass beads,
One bottle of the agent is supplied as an accessory.

10.2.4 Glass Beads (K9332ZJ)

These are for replenishing or replacing the glass beads used for automatic polishing of the indicator electrode, as beads are gradually lost or become so contaminated they cannot be cleanable.
The quantity required for replenishment and replacement depends on the operating conditions; in general, one to two packs per year.
Two packs of glass beads are supplied as the accessory.

10.2.5 Sand (K9720FZ)

This is a spare part required for raw water type and treated water type analyzers, and used in the following situations.

(1) When sand in the sand filter has decreased.

Flocks, etc. depositing in the sand filter are flushed and discharged from the sand filter by automatic water jet at regular intervals. If the frequency of the automatic cleaning is improper, sand can be discharged with the flocks, and sand in the sand filter decreases. As the sand filter must retain sand to a certain level, making-up for sand decrease is required.

(2) When the entire sand in the sand filter has discolored.

Although manganese and iron contained in sample water are contaminants of the electrodes, sand adsorbs most of the metals in the sample water, minimizing the contamination of the electrodes.
When the sand has adsorbed a quantity of metals such as to discolor the entire sand layer, the sand loses adsorption power and needs to be freshly replaced.

10.2.6 Valve Sheet (K9041HC)

It is recommended to replace the valve sheets on the suction and delivery sides of sample water and reagent metering pumps after use for six months to prevent possible trouble even if the sheets still show no defect.
Determine the quantity of spare valve sheets taking this scheduled replacement into account.

10.2.7 “Bellofram” (L9819AA, L9819AB)

“Bellofram” used in the piston sections of the metering pumps should be replaced after six-months use even if no defect has developed, as is the case with the valve sheet. “Bellofram” for the sample water metering pump and that for the reagent metering pump have different sizes.

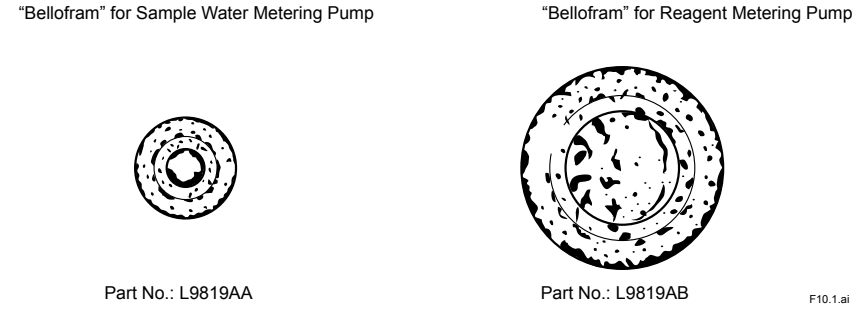


Figure 10.1 “Bellofram”

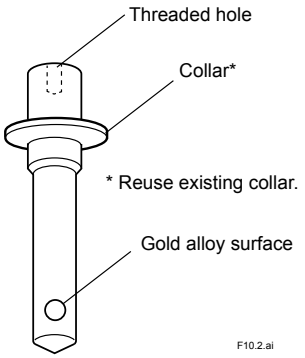
10.2.8 Indicator Electrode (K9334JP)

The indicator electrode is worn gradually by continual polishing with glass beads, and becomes unusable finally.
Wear being a dominant factor, service life of the indicator electrode is one to two years generally. (Note 1) A replacement electrode should be prepared in consideration of this life. However, at least one more electrode should be prepared at all times for accidental breakage or unexpected electrode failure.

(Note 1) Electrode life can be shortened by use in an erroneous condition such as “deflecting” rotation.
(Note 2) [Slope Display] by function code “9” in <MEAS.> mode can be used as a guide to the degradation of electrode characteristics. Notice in evaluation, however, that the slope indication value can be influenced by such factors as the contamination of electrodes including the counter electrode, set reference sensitivity, or manual analysis method used for measuring residual chlorine concentration of standard solution etc.

● Procedure for Applying Conductive Silicon Grease to Indicator Electrode

An electrical connection is required between the indicator electrode and the driven shaft. To ensure to secure the electrical connection, conductive silicon grease is applied to the female thread part of the indicator electrode. If not, apply grease by following the procedure below.



- Apply grease, taking care not to apply it to the outside (gold alloy side, in particular) of the electrode.
- Apply a half drop of grease to the tip of a small flat-head screwdriver and then transfer and apply it well to the three places (almost equally spaced) 3 to 5 mm below the edge of the threaded hole.
- Insert the indicator electrode in the driven shaft once. Remove it again and check that the grease does not run off to the edge. If so, remove the excess and clean the part with, for example, a cloth soaked in alcohol.

Note: Conductive silicone grease on the side of the electrode may interfere with accurate measurement. One apply of conductive silicone grease is enough.

10.2.9 Counter Electrode (K9332MJ), for Combined Chlorine (K9332MK)

The counter electrode can be used continuously without planned replacement, as it is not worn unlike the indicator electrode (rotating gold alloy electrode).
However, it is recommended to have a spare electrode providing for accidental breakage of electrode or other failures.

10.2.10 Fuse (A1113EF, A1109EF)

The fuse in the converter should be renewed once a year to prevent unexpected shutdown.

10.2.11 Brush (K9332JX) and Slip Ring (K9332JZ)

As the brush in the electrode mechanism block is used in contact with the rotating slip ring, both parts are worn over a long time. Generally, replacement every two years is standard. As a rule, replacement should be made as a pair.

NOTE

Do not touch the brush except when replacement is performed.

Procedures for adjusting the brush contact pressure and removing wear debris from the slip ring
Wear debris generated from the sliding action of the slip ring and brush (generated largely at the beginning), may enter between the slip ring and the brush, thereby temporarily increasing the contact resistance. This may cause a drop in readings. When this phenomenon occurs, polish and clean the surface of the slip ring to prevent the generation of wear debris and the ingress of wear debris generated into a space between the slip ring and the brush, and furthermore increase the contact pressure of the brush to the slip ring surface.

(1) Polishing and cleaning the surface of the slip ring

With the RC400G being powered, press sandpaper (#2000) on the rotating slip ring. Then, press a cotton swab soaked in alcohol on the rotating slip ring to wipe off debris.

(2) Increasing the brush contact pressure

Turn off power to the RC400G. Loosen the lock screw next to the contact pressure adjusting screw and then the 2 fixing screws for the brush mounting bracket. Turn the contact pressure adjusting screw in 1/2 turn.

Tighten the lock screws and bracket fixing screws. Make sure that the brush does not come in contact with the pulleys and does not come off the slip ring. Then turn on the power.

10.2.12 Driven Shaft Assembly (K9334JV)

The two bearings in the driven shaft assembly are used to rotate the rotary shaft smoothly. The bearings will be worn gradually and so should be replaced after approximately 3-year operation. The replacement, in principle, should be conducted by Yokogawa.

Note: It is recommended that the O-ring (P/N Y9115XB) in the electrode holder in the driven shaft assembly should also be replaced at the same time.

10.2.13 Drive Belt (L9804UK)

The drive belt will be worn or deteriorated gradually. It should be replaced after approximately 3-year operation.

10.2.14 Motor Assembly (See CMPL for Part Number)

The rotor in the motor assembly will be worn. The motor assembly should be replaced after approximately 3-year operation.

10.2.15 Gear Head (See CMPL for Part Number)

The rotor in the gear head will be worn. The gear head should be replaced after approximately 3-year operation.

10.2.16 Activated Charcoal Filter (L9862AY)

To secure accurate zero value, it is recommended that the filter be replaced once a year.

10.2.17 Filter (K9332NN)

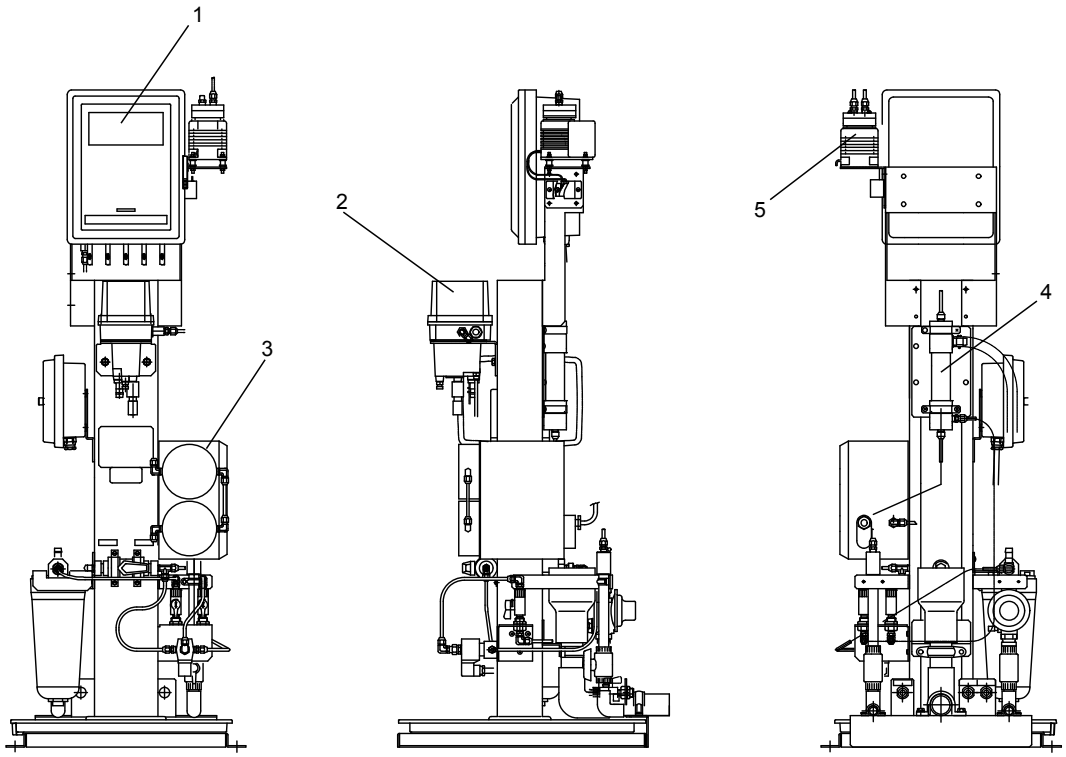
It is recommended that the filter which used for head tank or sand filter be replaced once a year.

Customer Maintenance Parts List

Model RC400G [Style: S3]
Residual Chlorine Analyzer

EXA RC

● Model RC400G - 1



Item	Part No.	Qty	Description
1	——	1	Converter (see page 4)
2	——	1	Detector (see page 5)
3	——	1	Metering Pump Assembly (see page 6)
4	——	1	Overflow Tank
5	——	1	Air Pump (Option)
	K9087XA		(For 100 V AC power supply)
	K9087XF		(For 110 V AC power supply)
	K9087XG		(For 200 V AC power supply)
	K9087XH		(For 220 V AC power supply)

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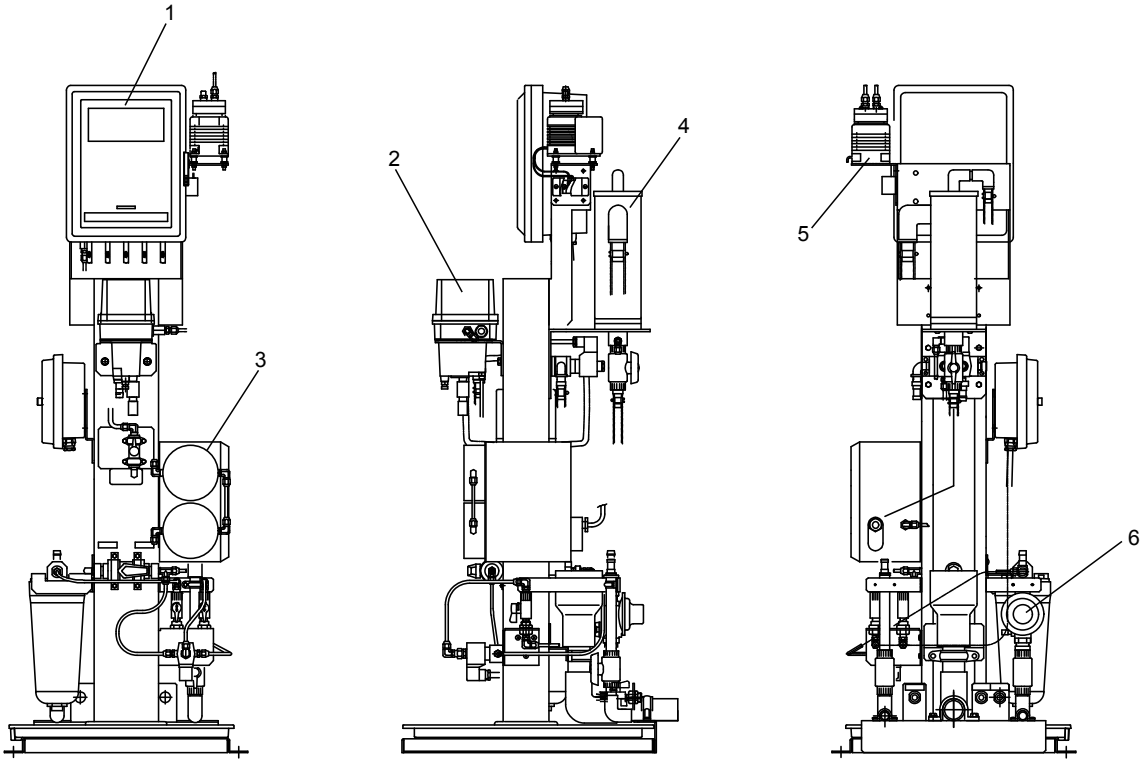
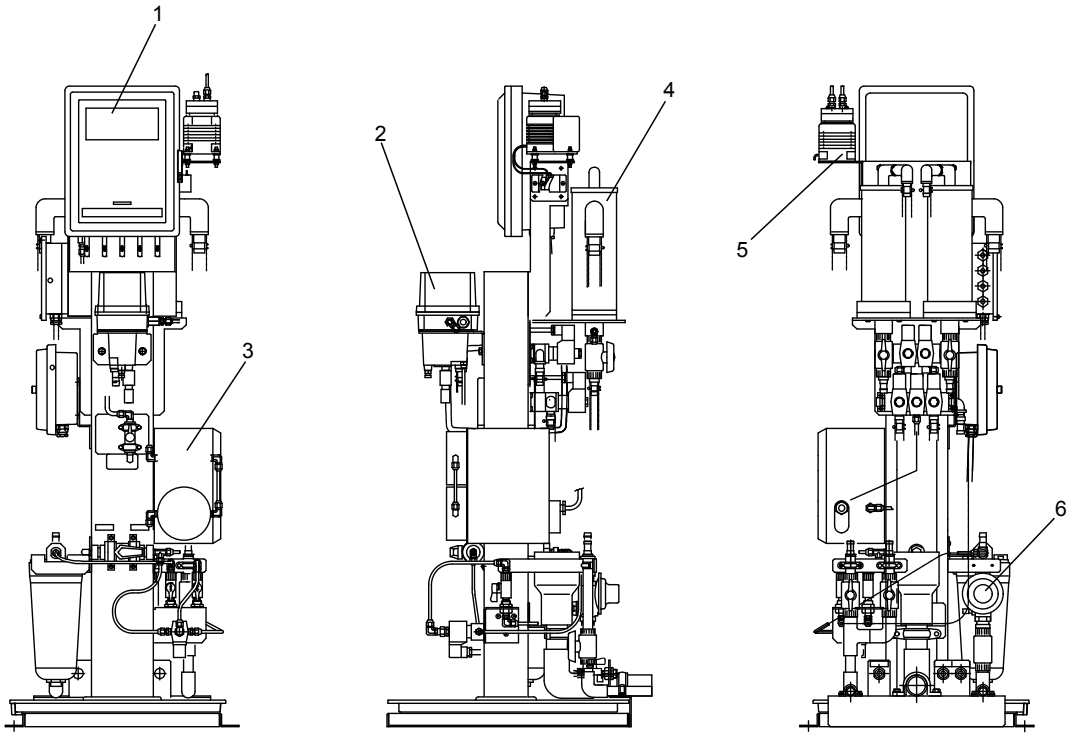
CMPL 12F04A01-03E
1st Edition : Mar. 2013 (YK)

● Model RC400G - 2



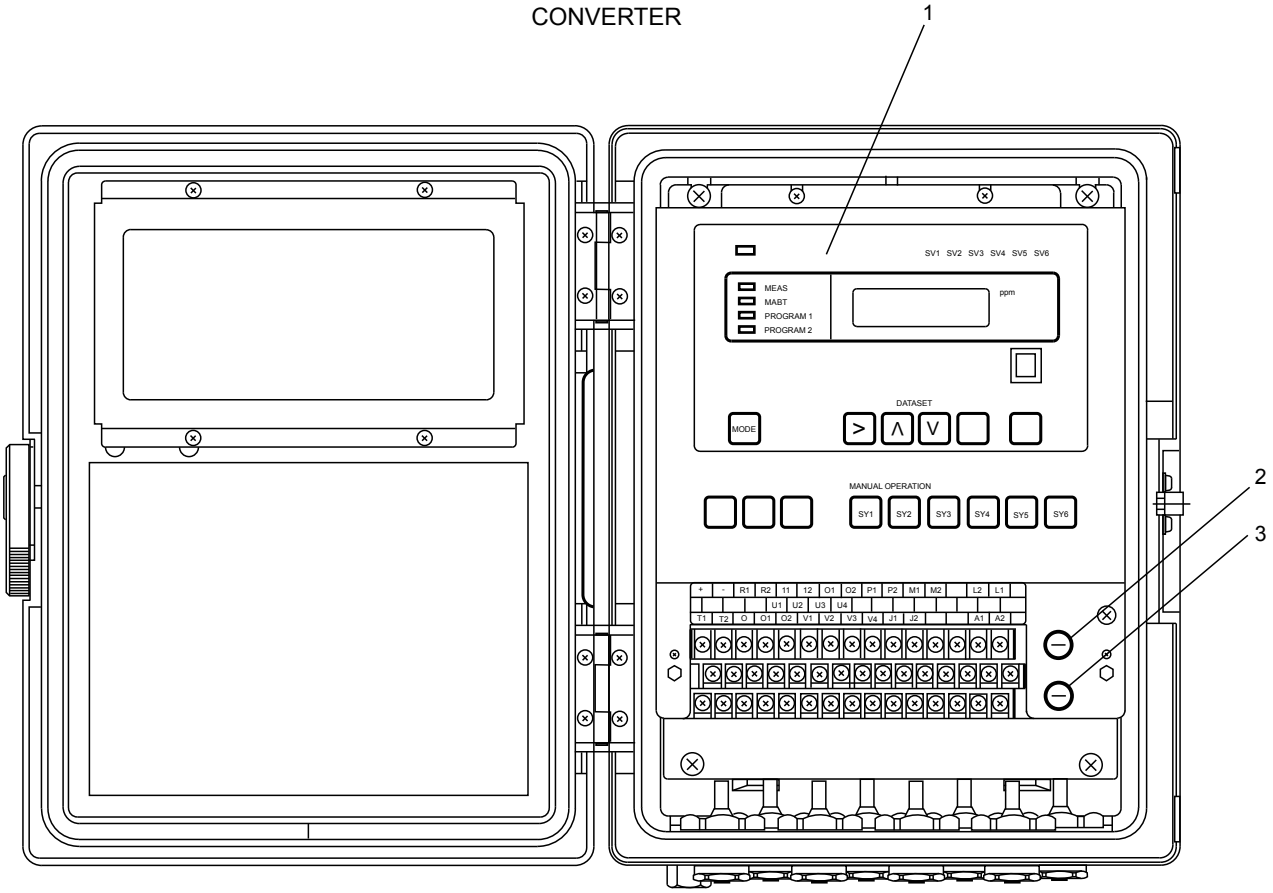
Item	Part No.	Qty	Description
1	——	1	Converter (see page 4)
2	——	1	Detector (see page 5)
3	——	1	Metering Pump Assembly (see page 6)
4	——	1	Sand Filter Assembly (see page 7)
5	——	1	Air Pump (Option)
	K9087XA		(For 100 V AC power supply)
	K9087XF		(For 110 V AC power supply)
	K9087XG		(For 200 V AC power supply)
	K9087XH		(For 220 V AC power supply)
6	K9326VG	1	Pressure Reducing Valve

● Model RC400G - 3



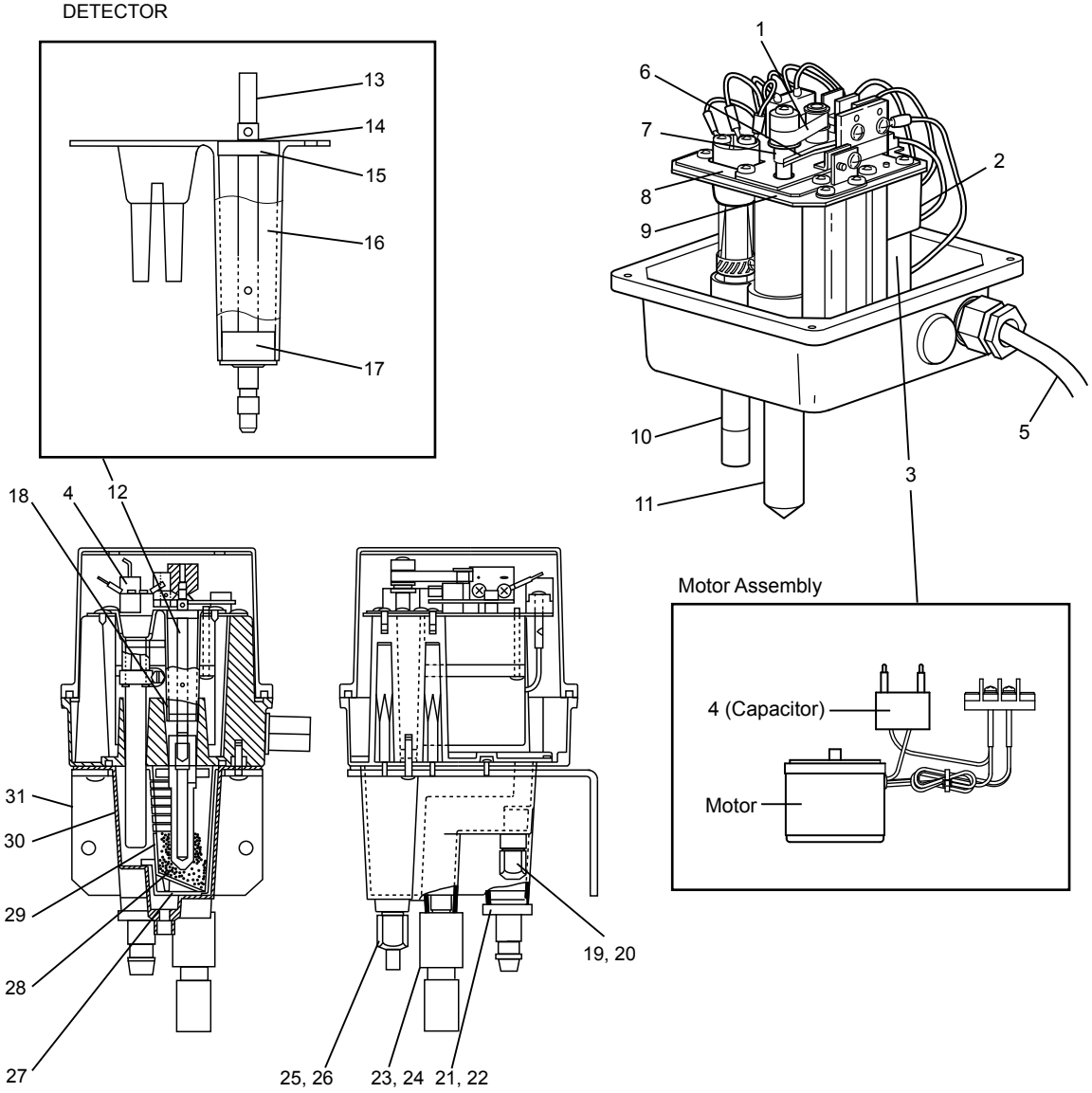
Item	Part No.	Qty	Description
1	——	1	Converter (see page 4)
2	——	1	Detector (see page 5)
3	——	1	Metering Pump Assembly (see page 6)
4	——	1	Sand Filter Assembly (see page 7)
5	——	1	Air Pump (Option)
	K9087XA		(For 100 V AC power supply)
	K9087XF		(For 110 V AC power supply)
	K9087XG		(For 200 V AC power supply)
	K9087XH		(For 220 V AC power supply)
6	K9326VG	1	Pressure Reducing Valve

CONVERTER



Item	Part No.	Qty	Description
1	——	1	Converter
2	A1109EF	1	Fuse (1 A)
3	A1113EF	1	Fuse (3 A)

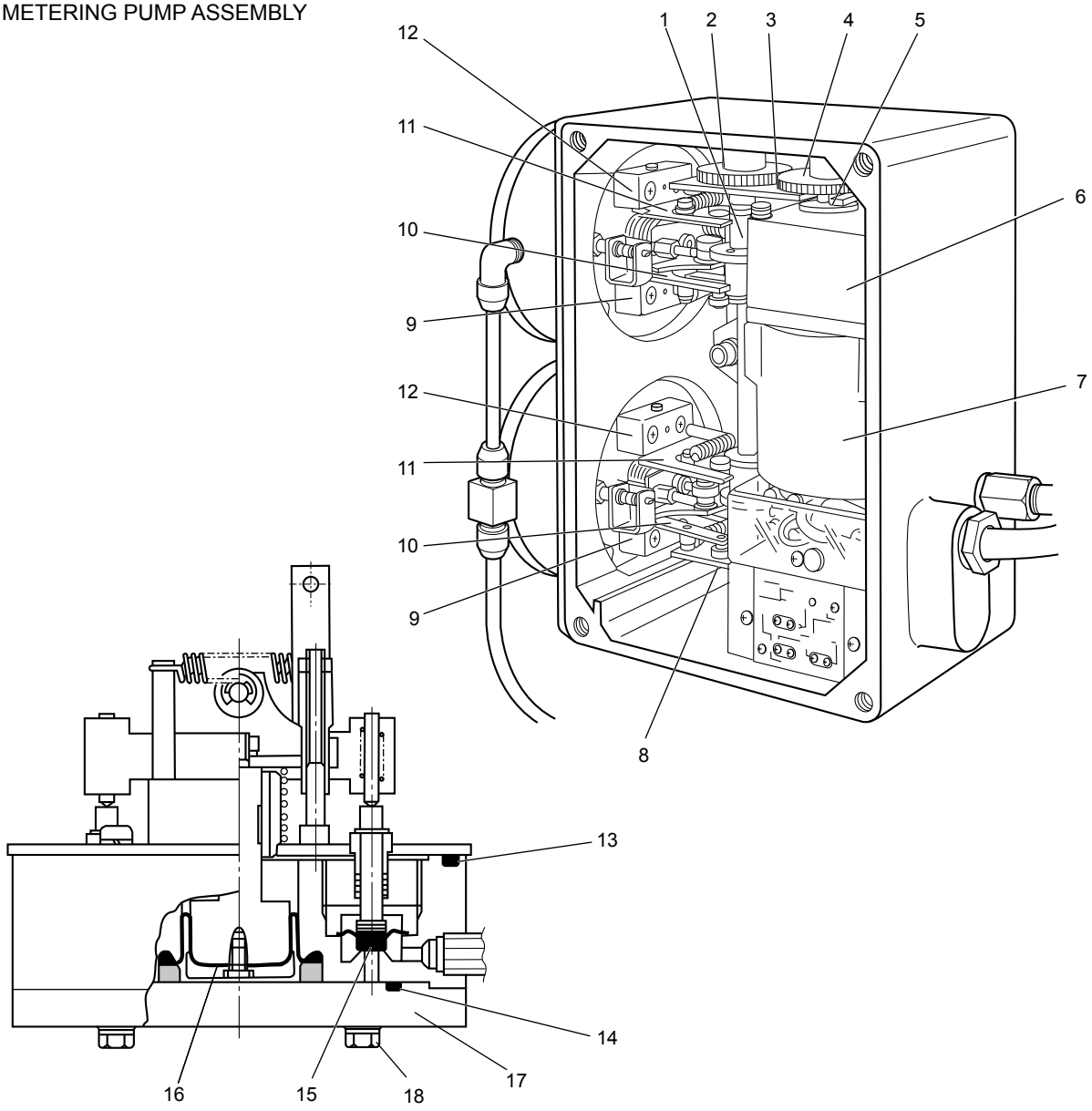
DETECTOR



Item	Part No.	Qty	Description
1	L9804UK	1	Drive Belt
2	—	1	Gear Head
	K9332JP		(For 100/110 V AC power supply)
	K9334VA		(For 200/220 V AC power supply)
3	—	1	Motor Assembly
	K9334JY		(For 100 V AC power supply)
	K9334VQ		(For 110 V AC power supply)
	K9334VR		(For 200 V AC power supply)
	K9334VS		(For 220 V AC power supply)
4	—	1	Capacitor
	K9334LK		(For 100 V AC power supply)
	K9332JS		(For 110 V AC power supply)
	A2022CF		(For 200/220 V AC power supply)
5	K9332WA	1	Cable
6	K9332JX	1	Brush
7	K9332JZ	1	Slip Ring
8	K9334LM	1	Plate
9	K9334LL	1	Plate
10	—	1	Counter Electrode
	K9332MJ		(For general type)
	K9332MK		(For combined chlorine insensitive type)
11	K9334JP	1	Indicator Electrode
12	K9334JV	1	Shaft Assembly
13	K9334LN	1	Shaft
14	Y9500ET	1	Retainer-ring-E
15	L9805BG	1	Bearing
16	K9332LQ	1	Holder
17	K9334JW	1	Bearing
18	Y9115XB	1	O-Ring
19	L9831HC	1	Nut
20	L9831HE	1	Sleeve
21	K9332KQ	1	Nipple
22	Y9114XB	1	O-Ring
23	K9332KR	1	Cock Assembly
24	Y9110XB	1	O-Ring
25	L9831KL	1	Nut
26	L9831KN	1	Sleeve
27	K9332KZ	1	Beads Case Cover
28	K9332ZJ	1	Beads
29	K9332KX	1	Beads Case
30	K9332KL	1	Measuring Cell
31	K9332MS	1	Bracket

6

METERING PUMP ASSEMBLY

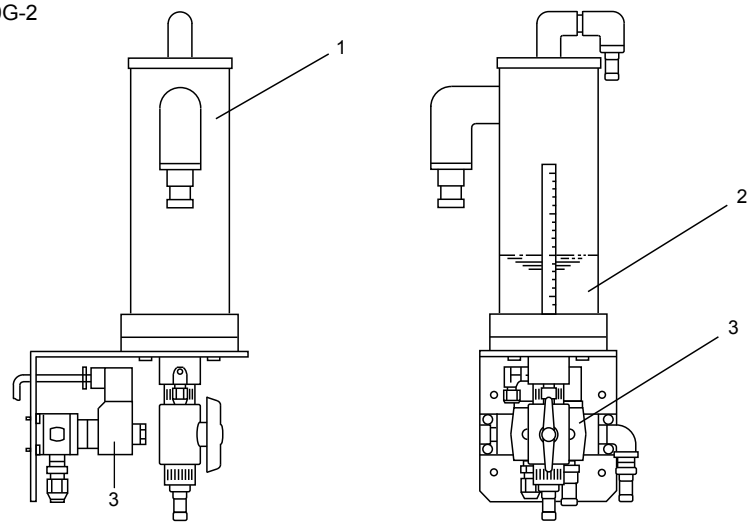


Item	Part No.	Qty	Description
1	K9041EA	1	Cam Assembly
2	K9041BT	1	Gear
3	K9041BK	1	Bracket Assembly
4	K9041DA	1	Gear
5	L9805GF	1	Bearing
6	K9041DF	1	Gear Head Assembly
7	K9041EN	1	Motor *1
	K9041EQ	1	Motor *2
8	K9041BP	1	Bracket Assembly
9	K9041JU	2	Block Assembly
10	K9041JK	2	Lever Assembly
11	K9041JA	2	Lever Assembly
12	K9041JP	2	Block Assembly
13	G9303AT	2	O-Ring
14	G9303AM	2	O-Ring
15	K9041HC	4	Valve Sheet
16	L9819AA	1	Bellofram (for Reagent Pump)
	L9819AB	1	Bellofram (for Sample Pump)
17	K9041FU	1	Plate (for Reagent Pump)
	K9041FP	1	Plate (for Sample Pump)
18	L9800EA	4	Screw (for each pump)

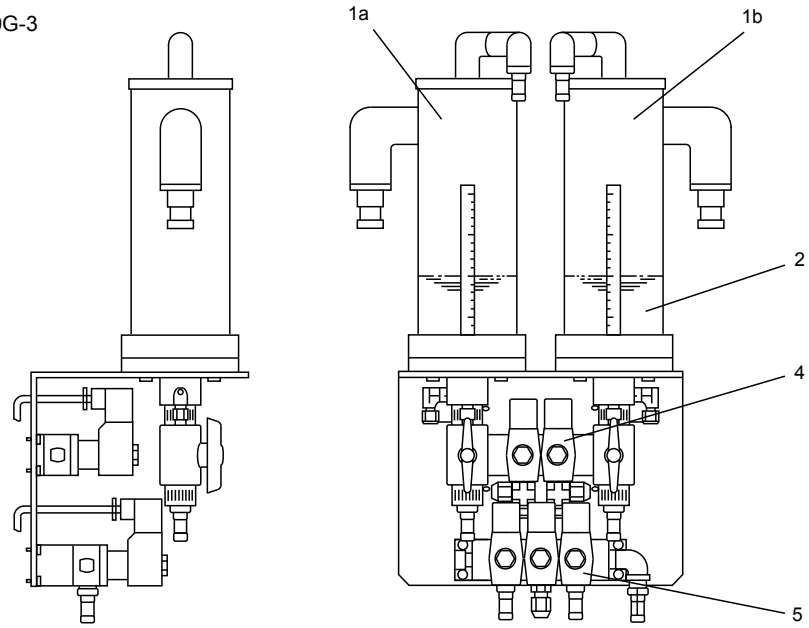
*1 Manufacturing date on the nameplate: Feb 2004 or later
*2 Manufacturing date on the nameplate: Jun 1995 to Jan 2004

SAND FILTER

● For Model RC400G-2

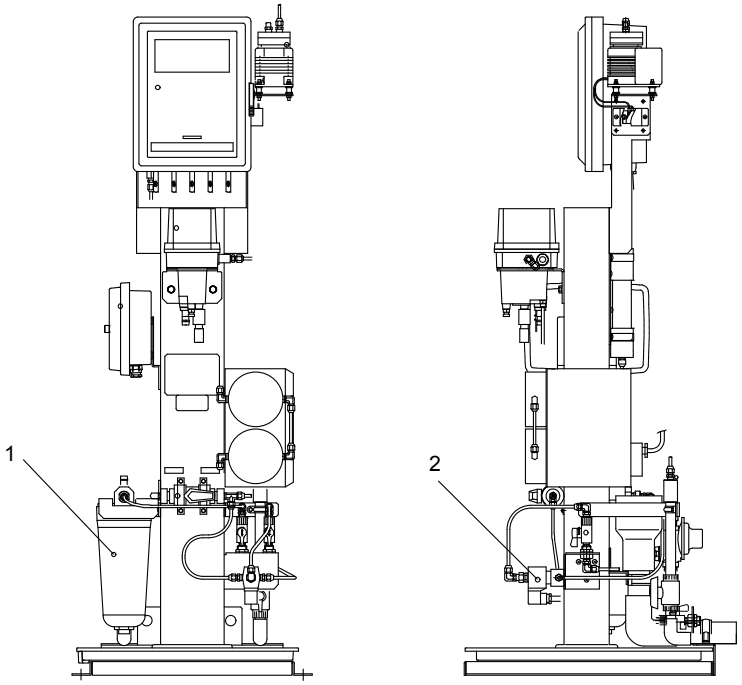


● For Model RC400G-3



Item	Part No.	Qty	Description
1	K9332NH	1	Filter Assembly (for Model RC400G-2)
1a	K9332PG	1	Filter Assembly (for Model RC400G-3)
1b	K9332PH		Filter Assembly (for Model RC400G-3)
2	K9720FZ	1	Sand (1 liter)
3	—	1	Solenoid Valve
	K9332RN		(For 100 V AC power supply)
	K9332RP		(For 110 V AC power supply)
	K9332RQ		(For 200 V AC power supply)
	K9332RR		(For 220V AC power supply)
4	—	1	Solenoid Valve
	K9332RW		(For 100 V AC power supply)
	K9332RX		(For 110 V AC power supply)
	K9332RY		(For 200 V AC power supply)
	K9332RZ		(For 220 V AC power supply)
5	—	1	Solenoid Valve
	K9332RS		(For 100 V AC power supply)
	K9332RT		(For 110 V AC power supply)
	K9332RU		(For 200 V AC power supply)
	K9332RV		(For 220 V AC power supply)

● Model RC400G/AZC with Auto Zero Calibration Option



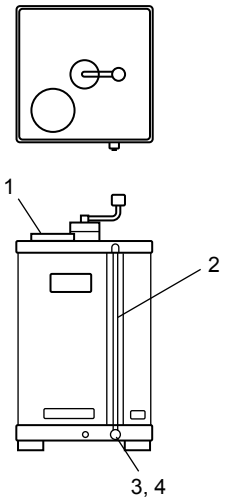
Item	Part No.	Qty	Description
1	K9726EG	1	Filter Assembly
	L9862AY	1	Filter Element
2	A1029MV	1	Solenoid Valve

Customer Maintenance Parts List

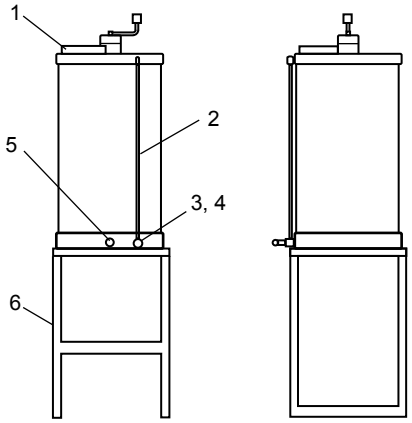
Model RC401G
Reagent Tank

EXA RC

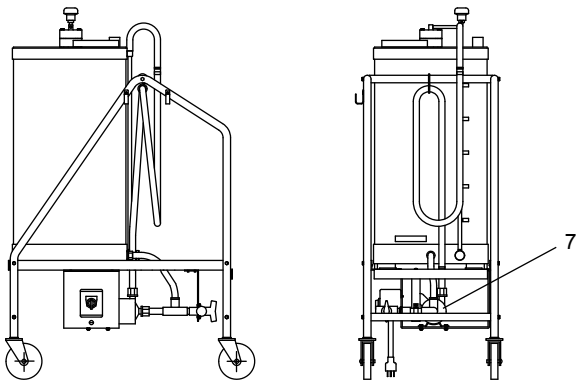
- **Model RC401G-A**



- **Model RC401G-B**



- **Model RC401G-C**



Item	Part No.	Qty	Description
1	K9041ZN	1	Cap
2	K9725GQ	1	Pipe
3	K9725GY	1	Plug
4	G9303NV	1	O-Ring
5	K9725HA	1	Needle Valve
6	K9332XA	1	Stand
7	L9869FJ	1	Pump *

* : Consult with Yokogawa for the product before April, 1999.

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CMPL 12F04A01-11E
5th Edition : Mar. 2013 (YK)

Revision Information

- Title : Model RC400G Residual Chlorine Analyzer [Style: S3]
- Manual No. : IM 12F4A1-01E

Aug. 2014/8th Edition
P.2-6, Addition of the note
P.4-6, Sec. 4.3.4 Addition of the explanation;
P.4-11, Sec. 4.3.13 Correction of the note;
P.5-2, Sec. 5.2 Addition of the explanation;
P.6-1, Sec. 6.1 Addition of the explanation;
P.6-3, Sec 6.1.4 Addition of the explanation;
P.6-4 to 6-5, Sec.6.5 Correction of contents;
P.9-7 and 9-8, Sec 9.1.2 (5) & (7) Addition of the explanation.

Mar. 2014/7th Edition
P.2-4, Addition of Regulatory Compliance;
P.2-7, Some note added for spare parts;
P.8-14, Addition of caution for replacement of motor assembly;
P.10-1, Some note added for spare parts.

Mar. 2013/6th Edition For Style S3
P.1-2, Indicator electrode changed to gold alloy electrode of Sec. 1.1 by style S3;
P.1-4, Change of applied voltage of Sec. 1.2 by style S3;
P.2-2, Indicator electrode changed to gold alloy electrode of Sec. 2.1.1 by style S3;
P.2-6, Style of RC400G MS-code changed to S3;
P.2-7, P/N change of fuse (3A) for spare parts, P/N of indicator electrode and driven shaft assembly changed by style S3;
P.2-12, Change of outline drawing for RC401G;
P.4-3, Indicator electrode of Figure 4.3 changed to gold alloy electrode by style S3;
P.4-5, Indicator electrode changed to gold alloy electrode of Sec. 4.2.2 by style S3;
P.4-9, Indicator electrode changed to gold alloy electrode of Sec. 4.3.10 by style S3;
P.4-10, Indicator electrode of Figure 4.8 changed to gold alloy electrode by style S3;
P.5-3, Change of applied voltage display of Table 5.3 by style S3;
P.5-5, Change of applied voltage setting of Table 5.5 by style S3, some addition of Table 5.5 - Function codes of “E.”, “F.” added (see below.) -,
Function code “E.”: Selection of negative (below-zero) display in <MEAS.> mode,
Function code “F.”: Selection of below-4-mA output hold in <MEAS.> mode;
P.5-21, Addition of description for function codes of “E.”, “F.”;
P.5-31 to 5-36, Addition of operation for function codes of “E.”, “F.”, and following pages layout changed;
P.6-2, Change of applied voltage in Figure 6.1 by style S3;
P.7-1, Indicator electrode changed to gold alloy electrode of Sec. 7.2 by style S3;
P.8-1, Indicator electrode changed to gold alloy electrode of Sec. 8.3 by style S3;
P.9-2, Indicator electrode changed to gold alloy electrode by style S3;
P.9-9, Change of applied voltage in Table 9.3 by style S3;
P.10-1, P/N change of fuse (3A) for spare parts, P/N of indicator electrode and driven shaft assembly changed by style S3;
P.10-3, Indicator electrode changed to gold alloy electrode of Sec. 10.2.9 by style S3, figure of electrode added, and Sec. 10.2.10 "Fuse (A1094EF)" changed to "Fuse (A1113EF)";
P.10-4, P/N change of Sec. 10.2.12 Driven Shaft Assembly;
CMPL CMPL 12F04A01-03E newly published for style S3, because P/N of indicator electrode and driven shaft assembly changed from CMPL 12F04A01-01(for style S2 or before), and CMPL 12F04A01-11E revised to 5th edition (edited by InDesign, contens are same).

Jun. 2011/5th Edition For Style S2
Remake and all pages changed;
P 2-6, Some revision of MS-code description;
P 2-7, Factory wastewater deleted from applications;
P 4-5, Some revision of Table 4.2;
P 4-7 to 4-8, Some error correction
P 5-3 to 5-6, Some revision of Table 5.3 to 5.6;
P 5-14 to 5-20, Some error correction, and some revision of Figure 5.6;
P 5-21 to 5-22, Some revision of “5.3.4 Key Operations in <PROGRAM.1> Mode”;
P 5-27, Addition of “(9) Setting Averaging Coefficient”, and following number of items revised;

P 5-33, Some revision of Figure 5.14;
P 6-4 to 6-5, Some revision of “6.5 Data Backup and Operation When Power is Turned ON Again”;
P 9-6, Some revision of Figure 9.4;
CMPL 12F04A01-01E revised to 9th edition (some revision of P/N in P 5 item 3, P 6 item 7).

Jan. 2010/4th Edition
P.2-11 Addition of note of reagent tank

Oct. 2009/3rd Edition
P.2-4 Change the specification (Response time);
P.2-5, P.2-7 Change the package of glass beads;
P.2-12 Correct dimensions of outline drawings;
P.8-5 Add notice for installation;
P.8-12 Change the tension of cogged belt;
Revise up CMPL CMPL 12F04A01-01E (8th Edition), CMPL 12F04A01-11E (4th Edition)

May 2007/2nd Edition
The overall review (Computerization)

Dec. 1992/1st Edition
Newly published

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